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Watershed Success Stories

Applying the Principles and Spirit of the Clean Water Action Plan

U.S.D.A., NAL
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Restoring & Protecting America's Waters

CLEAN WATER ACTION PLAN

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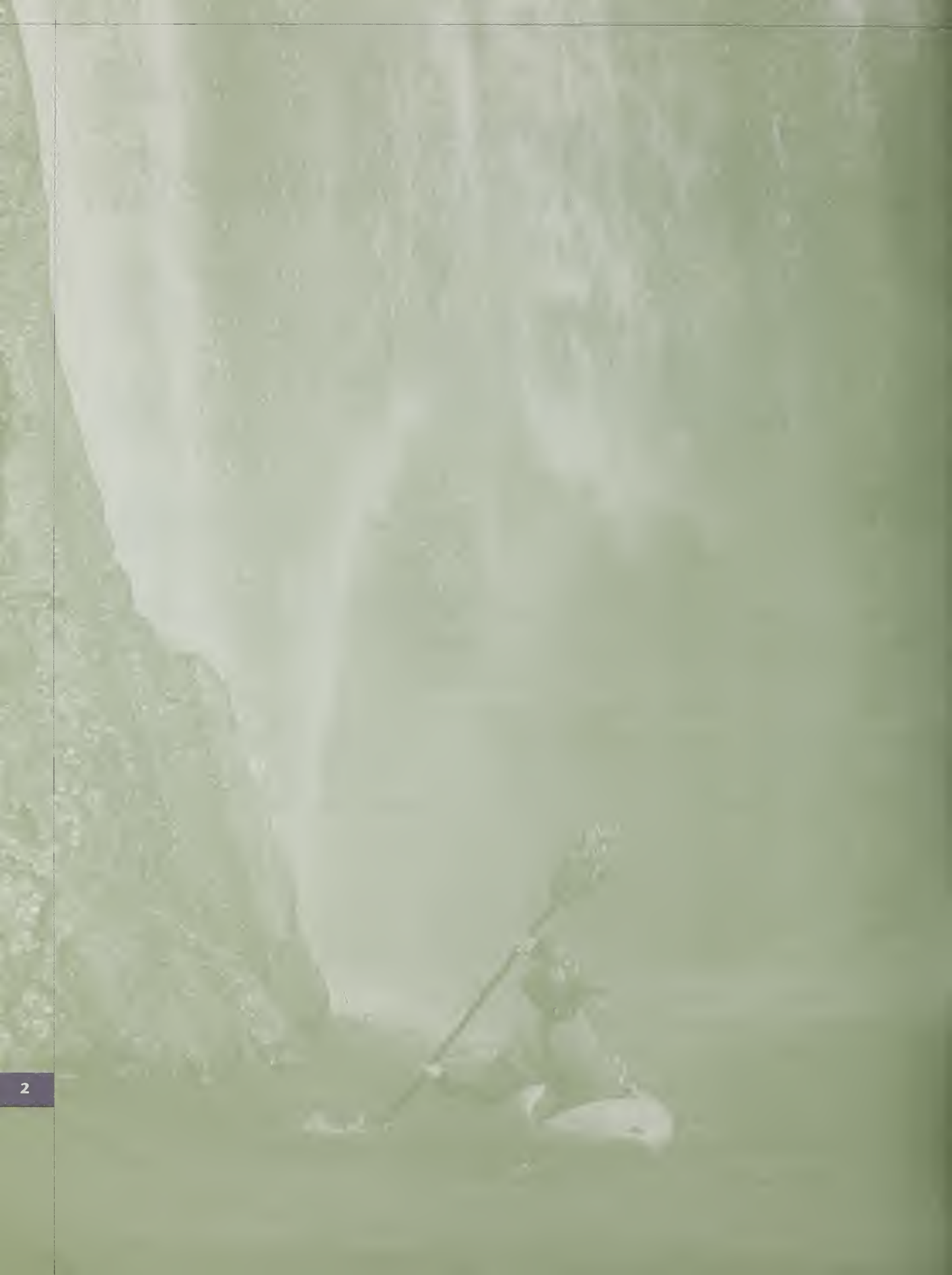


Introduction

Clean Water Action Plan Success Stories

In February 1998, President Clinton announced the Clean Water Action Plan, an effort designed by nine federal agencies to improve water quality nationwide. By viewing water quality problems on a watershed basis and coordinating both existing programs and new Action Plan initiatives, the federal government hoped to provide improved support for local watershed restoration efforts within the context of existing laws.

The Action Plan seeks to support the ongoing local watershed partnerships that are now in place and working to address critical local problems, develop restoration strategies and implement solutions that bring about real improvements in watershed health. This report highlights these successes by looking at individual case studies from around the country that embody the principles and spirit of partnership of the Clean Water Action Plan, regardless of when those local efforts started.

The thirty success stories presented in this report demonstrate how coordinating efforts of federal, state and local partners can lead to innovative restoration solutions to address a wide variety of water quality problems.

Partnerships and Public Participation

The Action Plan encourages federal agencies to provide opportunities for local, state, and tribal officials to formulate watershed restoration and protection plans. Thus, all of the case studies in this document highlight the degree to which watershed restoration must be a cooperative effort. Restoration efforts in the Wissahickon Watershed in Pennsylvania have been successful due to the efforts of 120 partner organizations. At the local level, in one subwatershed of the Bad River in South Dakota, nine of every ten landowners have participated in watershed restoration activities.

The Watershed Approach

A watershed is a geographic area in which all the falling water drains to a common water body, i.e. river, lake or stream. Watersheds may be as small as a few acres or larger than several states. Using data

2,149 Watersheds in U.S.

from the U.S. Geological Survey, the nation can be divided into 2,149 medium-sized watersheds, averaging about 1,700 square miles in each area. Each watershed provides a unique challenge and requires a unique solution. The Action Plan is the first federal attempt to use a watershed approach to fix water quality problems, coordinating programs which address point source and runoff pollution, wetlands and estuaries, agriculture and heavy industry.

Successful, ongoing local efforts to address priority water quality problems are found throughout the country. This report presents efforts taking place in a variety of locations ranging from major cities like New York and Philadelphia to remote communities in Alaska and on tribal lands. In accordance with existing laws, the Action Plan seeks to support these efforts by providing a coordinated framework for restoration activities. In late 1998 and early 1999, 50 states, five territories, and 80 tribes completed Unified Watershed Assessments that identify which of these watersheds are in need of restoration, preservation, or further investigation. The watersheds determined to be most in need of restoration efforts have been established as priorities for further efforts.

Watershed Restoration Action Strategies

Watershed Restoration Action Strategies have already been developed for some of these highest priority watersheds. These strategies describe the actions that will be taken by various stakeholders to help each watershed meet water quality goals. A variety of stakeholders play significant roles in each restoration effort, including local, state, and federal governments, private corporations, nonprofit organizations, and concerned citizens. The partnerships resulting from the stakeholders working together are invaluable to the success of the watershed restoration action strategies.

Although the federal government provided the impetus for the Action Plan and continues to provide technical and financial support for restoration efforts, local stakeholders have typically led restoration efforts. The importance of this leadership cannot be overstated. Only watershed residents and stakeholders can make the significant, lasting changes in behaviors and in land use and development that are often required to ensure clean waters for future generations.

Innovative Restoration

Each watershed provides a unique situation, and therefore each restoration effort has been similarly unique, and often quite innovative. For example, in Buzzards Bay, Massachusetts, constructed wetlands are being used to treat stormwater runoff that was impacting the bay's shellfish populations. In the Teanaway River Watershed in Washington, the Yakama Nation and the Bonneville Power Administration are constructing water conservation systems that will increase both instream flows and the reliability of the water supply for irrigation purposes. In the Oconaluftee and Ravens Fork Rivers Watershed in North Carolina, restoration partners are using their understanding of natural stream dynamics to restore the altered geology of impaired stream sections providing the widths, depths, meanders, slopes and pool spacings of healthy streams.

Improved Water Quality

Although many restoration efforts have just begun, some projects have already produced striking environmental results. A single project in Ohio has reduced erosion, preventing 400,000 tons of soil from muddying Big Darby Creek. A variety of restoration efforts in Bigalk Creek, Iowa has caused rainbow trout populations to increase sixfold since 1992. Restoration activities in the Illinois River Watershed have led to the return of fish species not seen in the river since 1908.

Moving Forward

The Clean Water Action Plan has helped federal agencies coordinate their efforts to assist local watershed organizations more effectively with restoration activities. Likewise, some states, territories and tribes are beginning to factor watershed restoration action strategies into their programs and plans for future restoration activities. Watershed solutions, such as those highlighted in this report, continue to gain momentum. These local efforts will make all of our waters fishable, swimmable and drinkable for future generations.

Watershed Success Stories Organized by Hydrologic Region

1. Buzzards Bay, MA
2. Barnegat Bay, NJ; Bronx River, NY; Wissahickon Creek, PA
3. Conasauga River, GA and TN
4. Cuyahoga River, OH; Little Rabbit River, MI
5. Big Darby Creek, OH; Conemaugh River, PA
6. Guest River, VA; Oconaluftee and Ravens Fork Rivers, NC
7. Bigalk Creek, IA; Illinois River, IL
8. Tensas River, LA
10. Boulder and Upper Tenmile Creek, MT; Upper and Lower Bad River, SD
11. North Fork of the Ninnescah River, KS
12. Clear Creek, TX
13. Willow Creek, CO
14. North Fork of the Gunnison River, CO; San Miguel River, CO
15. Little Colorado River, AZ and NM
16. Steamboat Creek, NV
17. Haskell Slough, WA; Teanaway River, WA
18. Napa River, CA; Panoche-Silver Creek, CA; Tijuana River, CA
19. Duck Creek, AK
20. Ko'olaupoko, HI

Acronyms

CWAP
Clean Water Action Plan

DOE
Department of Energy

DOI
Department of the Interior

EPA
Environmental Protection Agency

NOAA
National Oceanic and Atmospheric Administration

NRCS
Natural Resources Conservation Service

USDA
United States Department of Agriculture

Glossary

AMD - Acid Mine Drainage
Drainage that occurs as a result of chemical reactions in rock exposed to air and water. AMD impacts watersheds through increased acidity and elevated levels of heavy metals and total dissolved solids. It emanates from both surface and underground mine workings, waste and development rock, and tailings piles and ponds.

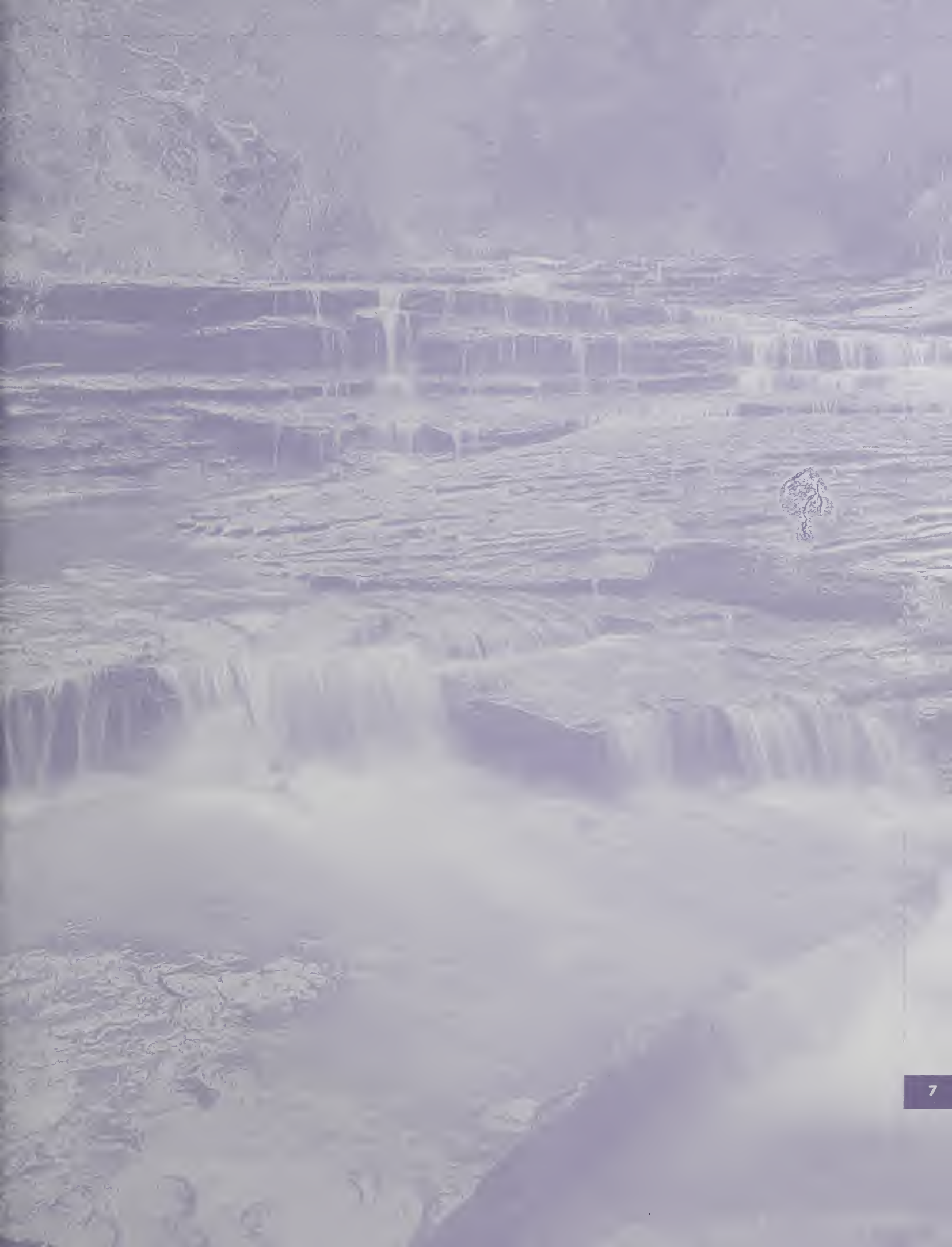
BMP - Best Management Practice
Common-sense action to keep soil and other pollutants out of streams and lakes. BMPs are designed to protect water quality and prevent new pollution.

GIS - Geographic Information System
Computer system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data related to positions on the Earth's surface. A typical system handles maps that contain layers of data about particular features.

NPS - Nonpoint Source
Unlike pollution from industrial and sewage treatment plants, nonpoint source pollution comes from many diffuse sources. NPS pollution is caused when rainfall or snowmelt moving over and through the ground, picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even underground sources of drinking water.

TMDL - Total Maximum Daily Load
A calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources.

WRAS - Watershed Restoration Action Strategy
Watershed Restoration Action Strategies spell out the most important causes of water pollution and resource degradation, detail the actions that all parties need to take to solve those problems, and set milestones by which to measure progress.



The Buzzards Bay Watershed

Restoring and Preserving Estuarine Resources

Renowned for its ecological resources, southeastern Massachusetts is among the fastest growing regions in the northeastern United States; its population may double in the next 20 years. The Buzzards Bay Watershed comprises over 275,000 acres, or 432 square miles, in 17 municipalities in this part of the state. The watershed is known for its variety of habitats, including salt marshes, tidal streams, eelgrass beds, tidal flats, barrier beaches, rocky shores and a number of subtidal habitats. In 1987, Buzzards Bay became one of four pilot estuaries in the Environmental Protection Agency's National Estuary Program (NEP), a program which now includes 28 estuaries.

A decline in water quality and degradation of shellfish beds and wildlife in Buzzards Bay are the results of the cumulative impacts of local land uses, such as agriculture, industry and recreation. Nonpoint source pollution from failing septic systems, farm animal wastes, stormwater and boat discharges contributes to the degradation of the watershed's resources. The pollution leads to nitrogen enrichment, pathogenic contamination of shellfish populations and the presence of toxic pollutants.

Restoring an Estuarine Ecosystem

The Buzzards Bay Project National Estuary Program is a venture of the Massachusetts Office of Coastal Zone Management and EPA. It studies regional water quality and living resources, assesses watershed health threats and develops long-term restoration strategies. The program works with local and community organizations, such as the 1,500-member Coalition for Buzzards Bay and the Buzzards Bay Action Committee.

In 1991, the Buzzards Bay Comprehensive Conservation and Management Plan was approved by the Commonwealth and EPA. The plan identified the problems facing the estuary and established long-term strategies for each problem. Stakeholders initiated projects to control stormwater runoff and protect shellfish resources, wetlands and coastal habitat by preventing oil pollution and managing sewage, nitrogen sensitive embayments, wastewater disposal systems and land use.

Shellfish Resources in Buzzards Bay

One of the long-term strategies involved the restoration of the eco-

logically valuable shellfish beds in Buzzards Bay. Studies and analysis determined that shellfish bed closings were increasing as a result of fecal coliform contamination conveyed principally by stormwater. Watershed partners established a series of efforts to reopen and preserve shellfish resources in the bay.

One of these efforts focused on Sprague Cove, a resource area located in the western section of the Town of Marion. This effort involved the town, Massachusetts Department of Environmental Protection, USDA Natural Resources Conservation Service, US Fish and Wildlife Service and Buzzards Bay NEP. A three-acre constructed wetland system was developed, consisting of a settling basin, shallow marshes, interior dikes and a stone-lined, vegetated channel. The system acts as a sediment and bacterial contamination treatment mechanism by increasing retention time and flow length while providing fish habitat.

Area residents supported the construction initiative with wetland plantings and bank vegetation replantings. Local stakeholders also participated in follow-up monitoring, sampling and project assessment. These samplings indicate that the wetland system has increased the viability of the shellfish resource area by removing sand, silt, trash and other debris from the stormwater discharge and reducing the level of fecal coliform bacteria. The shellfish bed restoration strategy is typical of water quality efforts in the Buzzards Bay Watershed. For each problem identified by the management plan, coordinated education efforts, restoration activities and monitoring have begun to improve the area's water resources.

The watershed is known for its variety of habitats, including salt marshes, tidal streams, eelgrass beds, tidal flats, barrier beaches, rocky shores and a number of subtidal habitats.

Photos courtesy of Sarah Wilkes

State and Federal Partners

The Buzzards Bay National Estuary Program receives financial support from the federal government and the State of Massachusetts. The Plymouth County Conservation District and the Bristol Conservation District are local sponsors for this watershed effort. Partners in state government include the Office of Coastal Zone Management, Department of Environmental Protection, Department of Fisheries, Wildlife and Environmental Law Enforcement and Cape Cod Commission. Federal support comes from the NOAA National Marine Fisheries Service, EPA, USDA Natural Resources Conservation Service and DOI Fish and Wildlife Service.

The Barnegat Bay Watershed

Stabilizing Erosion in an Estuarine Watershed

Even though it is only four feet deep on average and ranges from less than a mile to five miles at its widest point, Barnegat Bay supports a remarkable diversity of wildlife and habitats. The bay is an estuary covering 42 miles of New Jersey shoreline from the Point Pleasant Canal to Little Egg Harbor Inlet. The Barnegat Bay Watershed drains approximately 660 square miles in Ocean County, New Jersey. In recognition of the importance of the bay and the restoration and protection activities underway in the bay, Barnegat Bay was admitted into the Environmental Protection Agency's National Estuary Program in 1996.

Barnegat Bay is impacted by a variety of human activities. Development contributes to stormwater and nonpoint source pollution and increases runoff by decreasing open space and permeable land. Development also removes native vegetation, thereby degrading watershed habitats. Recreational and commercial use of the watershed exacerbates the already considerable natural erosion of Barnegat Bay's embankments. Dredging and bulkhead construction, while done to enhance the use of Barnegat Bay, often also increase sedimentation in the estuary and accelerate habitat loss.

Experiments in Bank Stabilization

Elevated levels of sedimentation are especially detrimental in Barnegat Bay because of its natural shallowness. To counter the effects of sedimentation, the Ocean County Soil Conservation District, USDA Natural Resources Conservation Service and Ocean County Board of Freeholders worked in conjunction with the National Estuary Program and initiated the Embankment and Restoration Project. The project was designed to coordinate the efforts of watershed stakeholders in bank stabilization and habitat restoration. The project also intended to demonstrate the practicality of using vegetative and bioengineering practices to stabilize eroding shorelines.

In 1995, the project partners completed an inventory to determine potential restoration sites and selected Beachwood Municipal Beach in the Borough of Beachwood, Cattus Island Park in the Town of Dover and Long Point in the Borough of Island Heights. Stabilization work began in 1996 and involved the installation of biologs and planting of native vegetation, some of which was provided by the Natural Resources Conservation Service Plant Materials Center in Cape May. The

coconut fiber biologs, which can be connected for steep or long streambanks, manage stream velocity and stabilize the shoreline. They are also fitted with fiber netting to provide a planting medium for vegetation. Work at the Cattus Island location combined biolog installation and native plantings with the installation of tires as breakwater structures.

Project partners learned a lot from these trial sites. Some native vegetation flourished while other species could not survive as a result of either persistent wave attack, storms or soils that were not conducive to plant growth. Similarly, bioengineering structures were hampered by a variety of obstacles. Where project efforts were successful, methods were documented for future replication, and where projects did not succeed, follow-up studies and research analyzed the results to guide future efforts.

Involving the Community

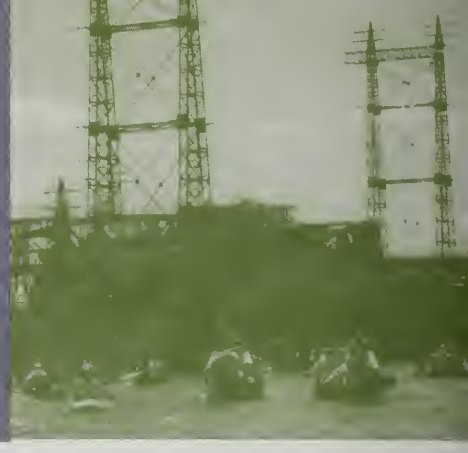
In addition to the restoration and protection activities, the Barnegat Bay Embankment and Restoration Project initiated numerous public outreach and education efforts. Through tours of restoration sites and a Coastal Restoration Workshop, the project has enhanced local understanding of the impact of human activities, especially regarding coastal bay and river erosion. Also, students from the Ocean County Vocational School supported watershed restoration education by preparing several public service announcements for local TV and radio stations.

Through tours of restoration sites and a Coastal Restoration Workshop, the project has enhanced local understanding of the impact of human activities, especially regarding coastal bay and river erosion

State and Federal Partners

The Barnegat Bay Embankment and Restoration Project received financial support from the federal government and the State of New Jersey, with local support from the Ocean County Soil Conservation District. State support comes from the Department of Environmental Protection. Federal partners include the USDA Natural Resources Conservation Service, NOAA, EPA, DOI Geological Survey, DOI Fish and Wildlife Service and US Army Corps of Engineers.

The Bronx River Watershed



Community Cooperation in Urban Watershed Restoration

A truly urban river, the Bronx River in the City of New York flows for 23 miles through the New York Botanical Garden, the Bronx Zoo, Soundview, Hunts Point and other communities before emptying into the Long Island Sound. The Bronx River Watershed encompasses 56.4 square miles in Westchester and Bronx Counties, New York.

In the early 1800s, the Bronx River watershed was characterized by a magnificent oak forest and abundant wildlife, including beaver and trout. The watershed also supported a major bird migration route, and the river itself powered the growing city's mills. However, the Bronx River Watershed has been subjected to the effects of urbanization since the 1840s, when the local railroad was built. Over 100 years of industrial pollution and urban sewer discharges have caused debris jams, flooding, excessive stormwater runoff, sedimentation, erosion, habitat loss and sewage overflows. The poor water quality of the Bronx River negatively impacts the watershed's value as a recreational, educational, ecological and economic resource.

Restoring the Urban River

Since the turn of the century, there have been many attempts to restore the Bronx River Watershed, but in 1997, the Urban Resources Partnership and Partnerships for Parks formed the Bronx River Working Group to coordinate watershed restoration, education and outreach efforts. Supported by an EPA Wetlands Protection grant and financial assistance from the US Department of Transportation, the continuously expanding alliance of over 50 community groups, non-profits, businesses and government agencies - new partners and stakeholders are joining - holds bi-monthly meetings to organize its implementation activities.

Participation in the Bronx River Working Group is completely voluntary. No federal or state actions mandate involvement, and each organization participates to the extent that its resources and mission match the needs of the initiatives. Also, the Bronx River Working Group has developed five action teams, which help focus the alliance's resources and expertise, thereby resulting in a high level of understanding of community needs and fostering better comprehension of technical issues by community members.

Bronx River Working Group Initiatives

The Bronx River Working Group is accomplishing significant watershed restoration and protection objectives by acquiring land, restoring river channel hydraulics, stabilizing eroding riverbank with native vegetation, reclaiming wetlands and floodplains, improving habitat and increasing public access to the river. Many projects and actions are underway, including a mile-long greenway project in the Soundview section of the watershed, a com-

bined sewer overflow abatement project, composition of a comprehensive watershed management plan, establishment of new parks and introduction of community stewardship initiatives.

Public outreach projects, such the Adopt-The-River Program, are critical to restoration efforts and increased public participation and awareness. A City of New York Department of Parks and Recreation initiative, the Adopt-The-River Program provides technical and financial assistance to community-based projects. In the fall of 1999 alone, 15 program community events focused on reopening riverside trails, removing debris from the river, restoring wildlife habitat and developing waterfront access. The program's quarterly newsletter has a circulation of over 4,000 and informs Bronx River stakeholders about river events, workshops and cleanups.

Bronx River Golden Ball

A crucial aspect of this urban river cleanup project is the extensive community involvement. Project area tours and "river cleanup days" are highly effective and foster a cooperative relationship among local stakeholders, residents and involved governmental agencies, such as the National Park Service. Special events, like the Bronx River Golden Ball, combine art, community and the environment to celebrate the river, its history and its restoration. Organized by 30 community groups, the Golden Ball involved floating a 36-inch golden orb down 10 miles of the river and drew a wide spectrum of media attention. Similarly, the May 1998 Bronx River Garden Festival at the Lorraine Hansbury Park, a former vacant lot, was attended by more than 160 individuals and included nature walks led by Urban Park Rangers, canoe rides and gardening workshops and plantings.

Public outreach projects are critical to restoration efforts and increased public participation and awareness

Bronx River Working Group participants have already noticed gradual improvements in the watershed. The US Army Corps of Engineers will support the continuing watershed effort by conducting a study that will explore ways to decrease flooding, enhance indigenous habitats and improve water quality. It is hoped that new projects will build upon this success and continue to improve the area's water quality and habitat. Successful protection and preservation of the Bronx River will play a central role in the beautification and revitalization of the rest of the watershed.

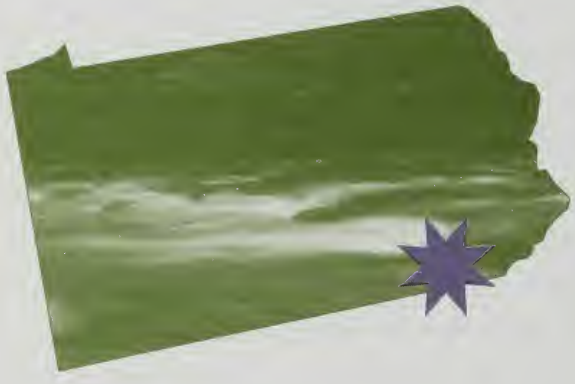
State and Federal Partners

The Bronx River Working Group receives financial support from the federal government, State and City of New York, Partnership for Parks, City Parks Foundation, River Network, Our Lady of Mercy Medical Center, Bronx Zoo, The Point CDC, Patagonia and Con Edison, as well as local support from the New York City and Westchester County Soil and Water Conservation Districts. Partners in state government include the Department of Environmental Conservation, Department of Environmental Protection, Department of Transportation, Attorney General's Office and Cornell University Cooperative Extension Service. Federal support comes from the Urban Resources Partnership, US Army Corps of Engineers, NOAA, DOI National Park Service, DOI Fish and Wildlife Service, Department of Housing and Urban Development, EPA, USDA Natural Resources Conservation Service and USDA Forest Service.

The Wissahickon Creek Watershed

Countering Urban and Suburban Development Effects

Located in the City of Philadelphia metropolitan area, the Wissahickon Creek Watershed spans approximately 64 square miles in Montgomery and Philadelphia Counties in southeastern Pennsylvania. The Wissahickon Creek flows 23 miles from Lansdale Borough to the Queen Lake Reservoir drinking water intake located on the bank of the Schuylkill River. The creek passes through Fairmount Park, the largest park entirely contained within a city and a national Natural History Point of Interest. The Wissahickon Creek is classified as a trout stocked fishery under the 1997 Pennsylvania Water Quality criteria.



Over time, the Wissahickon Creek Watershed has experienced continual urban and suburban development. Land use in the watershed is now 45 percent residential and 21 percent commercial or industrial. Thirty-four percent of the land remains undeveloped. The watershed, with a population of 100,000 in 1990, contains the Boroughs of Ambler, North Wales and Lansdale, part of the City of Philadelphia and nine townships. The water resources of the watershed serve the region's drinking water needs and recreational uses.

The effects of dense population and constant development in this urban watershed have degraded essential water resources. These water resources are impacted by point source and nonpoint source pollution. One origin of the point source pollution is the watershed's 90 permitted discharges, 63 of which are stormwater outfalls, and many non-permitted discharges from urbanized areas, housing developments, parks, farms, residential and commercial land and school, college and corporate campuses. Point source and nonpoint source pollution are causing excessive sedimentation, flooding and eutrophication in the Wissahickon Creek and threaten the watershed's use as a drinking water supply, a recreational area and as wildlife habitat.

Restoring the Urban Watershed

As a joint initiative of the Pennsylvania Department of Environmental Protection, Montgomery County Planning Commission and Fairmount Park Commission, the Wissahickon Watershed Partnership was formed in the spring of 1997. The partnership, which meets quarterly, now includes approximately 120 partners and provides a framework for coordinating the initiatives of the watershed's stakeholders.

Four Major Projects, 120 Partners

The Wissahickon Watershed Partnership is currently focused on four projects. One project, the Paper Mill Run Riparian Restoration and Demonstration Project, has three phases. The first phase, development of a comprehensive riparian restoration plan, has been completed. The second phase, demonstration of best management practices (BMP) for stream channel, bank and area plantings with interpretive exhibits, is underway. The third phase will complement the demonstration BMPs with workshops, publications and education and outreach programs.

Another project, the Wissahickon Riparian Restoration and Trail Link, is developing a master plan for creation of a 3.5-mile greenway zone that will allow regulation and land use management of the watershed's recreational resources. A third project, the Wissahickon Watershed Pilot Program, will employ a watershed approach, Geographic Information Systems (GIS), modeling and Total Maximum Daily Load (TMDL) studies to determine cost-effective solutions to point and non-point source pollution, stormwater runoff and streamside land use problems.

The cooperation and coordination between the partnership's 120 partners provide a model for the restoration and preservation of an urban watershed

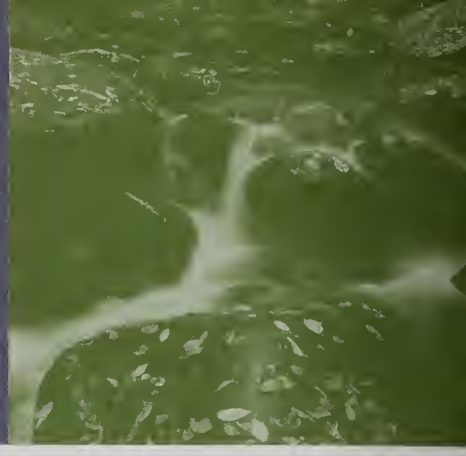
A fourth project, led by the National Institute for Environmental Renewal, is developing a coordinated environmental monitoring and data management system. The system integrates GIS, sensor and environmental site data and allows project participants to analyze the effectiveness of certain BMPs and other actions.

The Wissahickon Watershed Partnership has made significant progress in developing projects that improve water quality and wildlife habitat in the watershed, and as each project advances, these improvements are expected to continue. The cooperation and coordination between the partnership's 120 partners provide a model for the restoration and preservation of an urban watershed.

State and Federal Partners

The Wissahickon Watershed Partnership receives financial support from the federal government, State of Pennsylvania, City of Philadelphia, Wissahickon Valley Watershed Association, Friends of the Wissahickon, William Penn Foundation and the Montgomery County Conservation District. Partners in state government include the Department of Environmental Protection and the Department of Conservation and Natural Resources. Federal support comes from the DOI Geological Survey, EPA, USDA Natural Resources Conservation Service, Department of Energy and Department of Defense.

The Conasauga River Watershed



Protecting Wildlife Habitat from Nonpoint Source Pollution

The 91-mile Conasauga River is home to a remarkable diversity of species, including 25 that are considered rare. One species, the Conasauga logperch, is found in a 12-mile stretch of the river and nowhere else in the world. The river originates in the Chattahoochee National Forest, in the mountains of northwest Georgia, flows into Tennessee and returns to Georgia to become part of the Coosa Basin System that continues toward Mobile Bay. In 1999, the USDA Forest Service selected the watershed as one of 12 priority large watersheds, and the river has been identified as one of the most biologically important rivers in the southeast United States.

The Conasauga River Watershed is impacted by urban, forestry and agricultural activities. The river's resources are utilized for both industrial, agricultural and recreational purposes. Over time, habitat modification and nonpoint source pollution from highway and land use runoff have impaired the watershed. Although real progress has been made, eighteen miles of the Conasauga River and 54 miles of tributaries are still in Georgia's List of Impaired Waters for fecal, metal, toxic chemical, sediment and nutrient impacts. The Conasauga River Watershed is classified as a Category 1 priority watershed in the state's Unified Watershed Assessment.

Combating Habitat Modification

In 1994, the Limestone Valley Resource Conservation and Development (RC&D) Council undertook an ecosystem-based assistance study and organized meetings of local stakeholders. Three years later, the council founded the Conasauga River Alliance, a partnership made up of local citizens, conservation groups and federal, state and local agencies. The alliance is addressing the degradation of habitat and water quality caused by erosion, sedimentation, excessive nutrients and toxic chemicals in the watershed. The alliance also works with other organizations and stakeholders, such as represen-

tatives of the Cherokee and Chattahoochee National Forests, to improve watershed conditions in Georgia and Tennessee.

The Conasauga River Alliance has worked with landowners and agency representatives to support enrollment of nearly 200 acres of riparian area in the USDA Conservation Reserve Program. The alliance has also placed over 25 miles of riverbank and streambank under some form of conservation management and planted 11,000 trees.

Numerous public participation activities and best management practice demonstrations, involving practices such as prescribed grazing, animal waste and nutrient management and streambank stabilization, enhance public awareness and education. The alliance is implementing a comprehensive watershed management plan that includes 24 demonstration projects to address nonpoint source pollution and habitat modification. The partnership has also designed and implemented a water quality monitoring program.

State and Federal Partners

The Conasauga River Watershed stakeholders receive financial support from the federal government, Dalton Utilities and The Nature Conservancy, and local support through the Bradley County (TN) and Polk County (TN) Soil Conservation Districts, Southeast Tennessee and Limestone Valley (GA) Resource Conservation and Development Councils and Limestone Valley (GA) Soil and Water Conservation District. State partners include the Georgia Department of Natural Resources, Georgia Forestry Commission, University of Georgia and Tennessee Department of the Environment. Federal support has come from the USDA Farm Services Agency, USDA Natural Resources Conservation Service, USDA Forest Service, EPA and DOI Fish and Wildlife Service.

The Conasauga River Alliance has placed over 25 miles of riverbank and streambank under some form of conservation management and planted 11,000 trees

The Cuyahoga River Watershed

Restoring an American Heritage River

A critical part of this country's environmental history, the Cuyahoga River travels 100 miles from Geauga County, past Cuyahoga Falls, and through the Cuyahoga Valley National Recreation Area located between the urban and industrial centers of Akron and Cleveland, before emptying into Lake Erie. The Cuyahoga River Watershed drains 813 square miles in Cuyahoga, Summit, Portage, Geauga and Medina Counties in northeast Ohio.

The Cuyahoga River played an important role in the birth of the environmental movement. In 1936, a spark from a blow torch ignited floating debris and oils and set the river on fire. The river was plagued by fires until 1969, when a fire caught the attention of the nation and helped spur a great deal of environmental legislation, including the Clean Water Act, the Great Lakes Water Quality Agreement and the creation of national and state Environmental Protection Agencies. As a result, large point sources of pollution on the Cuyahoga have received significant attention from the Ohio Environmental Protection Agency in recent decades. Water quality has improved and, in recognition of this improvement, the Cuyahoga River was designated as one of 14 American Heritage Rivers in 1998. Yet, pollution problems, particularly nonpoint source problems, remain. For this reason, the Environmental Protection Agency classified portions of the Cuyahoga River Watershed as one of 43 Great Lakes Areas of Concern, warranting development of a Remedial Action Plan (RAP).

The RAP

The Cuyahoga Remedial Action Plan process began in 1988 when the Ohio Environmental Protection Agency formed the Cuyahoga River RAP Coordinating Committee (CCC), consisting of 33 representatives from local, regional, state and federal agencies, private corporations, and citizen and environmental organizations. The mission of the RAP is to plan and promote the restoration and preservation of beneficial uses of the lower Cuyahoga River and near-shore Lake Erie through remediation of existing conditions and prevention of further pollution and degradation. Sources of water quality impairment have been identified and are being addressed through a variety of restoration activities.

Several demonstration projects have been constructed that show the potential of bioengineering techniques for stream restoration. These projects demonstrated a variety of successful remedies for soil erosion and flooding problems. Other types of projects include the City of Akron's separate sewer overflow elimination program and plans to address combined sewer overflows.

A variety of research studies have been funded to promote understanding of water quality impairments and aid in the development and refinement of educational programs. Studies include navigation channel re-aeration feasibility, fish advisories, creel surveys, community preference polls, fish tissue, phytoplankton and larval fish studies, US Geological Survey bacterial studies and bioengineering projects.

Community Involvement

The Cuyahoga River Watershed RAP strives to reduce water pollution levels and enhance stewardship of the watershed's resources by boosting community awareness and involvement in local restoration efforts. More than 50 educational RAP presentations are made annually to civic, school and professional groups. Five thousand storm drains have been stenciled to discourage inappropriate dumping. Biannual newsletters update approximately 6,500 stakeholders.

Watershed-wide restoration efforts like river and stream cleanups, biological stream monitoring by volunteers and interested groups and an annual Riverday are supported by more closely focused activities based in municipal and township units. Programs such as the Big Creek Stream Stewardship Program involve locally-based education and outreach activities, habitat improvement projects, data collection and storm drain stenciling. Scouts can earn the "Cuyahoga River RAP Stream Stewardship" patch by working on a number of volunteer and educational activities.

Noticeable environmental improvements have already been recorded in the Cuyahoga River. A 1998 larval fish study documented usage of the river as a navigation channel for Lake Erie fish migration. Follow-up studies in 1999 confirmed these results and documented the presence of steelhead trout adults.

The Cuyahoga River played an important role in the birth of the environmental movement

State and Federal Partners

The Cuyahoga River Watershed RAP receives financial support from numerous sources including the federal government and the State of Ohio, and local support through the Soil and Water Conservation Districts in Cuyahoga, Geauga, Portage and Summit Counties. State partners include the Department of Natural Resources, Department of Health and Ohio Environmental Protection Agency. Partners in federal government include the DOI National Park Service, US Army Corps of Engineers, EPA, USDA Natural Resources Conservation Service and USDA Forest Service.

The Little Rabbit River Watershed

Using Best Management Practices

Land in the Little Rabbit River Watershed is 73 percent agricultural, 17 percent woodland, 7 percent urban and 3 percent water and wetland. The midwestern watershed drains sections of four townships in Allegan and Kent Counties in southwest Michigan. The Little Rabbit River itself flows to the Rabbit River, a tributary of the Kalamazoo River, which empties into Lake Michigan. The 30,850 acre (48.2 square mile) watershed is a sub-watershed of the Kalamazoo River Basin.

The Little Rabbit River is designated as both a public water supply and a warmwater fishery. Pressures from agriculture, urban sprawl and increasing populations in the area threaten the sustainability of these designated uses. The watershed is negatively impacted by sedimentation from streambanks, cropland, construction sites and road crossings and ditches. Excessive nutrients from agricultural production, inadequate septic systems, animal waste and residential area runoff and high flows from uncontrolled stormwater also damage the Little Rabbit River.

Cleaning Up the Little Rabbit River

In the early 1990s, stakeholders in Little Rabbit River Watershed met to discuss potential actions to mitigate the effects of nonpoint source pollution from sediment, nutrients and stormwater flows. They also sought to include water quality considerations into development and land use planning processes. In 1995, the broad partnership, involving local, state and federal stakeholders, completed a Watershed Management Plan that outlined the goals and objectives of the project. The partnership also successfully submitted the Little Rabbit River Watershed to USDA's Environmental Quality Incentives Program as a Conservation Priority Area.

The partnership created a resource management system involving sixteen different best management practices (BMPs) on over 17,000 acres. The partners, with help from the USDA Natural Resources Conservation Service, constructed 14,108 feet of exclusion fencing, 7 stream crossings and 7 watering

facilities for pasture management. Ten animal waste management systems, an erosion control structure and a sediment detention basin were created. The stakeholders also incorporated 4,750 acres into crop residue management and assembled 135.9 acres of filter strips. As part of the resource management plan, BMPs in critical areas, priority fields and other problem sites qualified for federal cost-sharing, which can fund up to 75 percent of the total cost of the project.

Other aspects of the management plan complemented the BMPs. Stakeholders in both Lake Macatawa and Lake Allegan initiated Total Maximum Daily Load (TMDL) studies for phosphorous and are developing plans to reduce phosphorous levels. Allegan County formed a Geographic Information System (GIS) Department and generated map layers and models to assist various projects. The information and education program increased public awareness of watershed and water quality concerns. Newsletters, flyers, brochures and meetings enhanced public participation in watershed restoration.

Working with Town Ordinances

The Little Rabbit River Watershed stakeholders developed mechanisms for the continuation of project goals and objectives in the years following project completion.

Township ordinances were reviewed and changed to take water quality into greater consideration. For example, Dorr Township passed a conservation subdivision zoning amendment which requires 40 percent of the land under development to remain as open space, with the rest committed to cluster housing. Salem Township amended its zoning regulations to limit development on prime agricultural land. Such ordinances increase pervious surfaces and create pollutant-filtering buffer zones around natural areas. The watershed's townships are also considering an amendment that would prohibit any new development within the floodplain delineation.

The Little Rabbit River Watershed stakeholders have used town ordinances, BMPs and educational outreach programs to focus the public's attention on the watershed's future. By raising public awareness, the partners hope to effectively change behavior, enhance local stewardship and perpetuate their progress beyond the life of the projects.

State and Federal Partners

The Little Rabbit River Watershed projects receive financial support from the federal government and the State of Michigan; the Allegan Conservation District provides local support as a grants coordinator. State partners include the Department of Natural Resources, Department of Environmental Quality, Department of Agriculture and Michigan State University Cooperative Extension Service. Federal support comes from the USDA Farm Services Agency, USDA Natural Resources Conservation Service and EPA.

The partnership created a resource management system involving sixteen different best management practices on 17,089 acres

The Big Darby Creek Watershed

Preserving Biological Diversity in an Agricultural Watershed

Known nationally for their diversity and abundance of aquatic and terrestrial plants and animals, Big and Little Darby Creeks are home to 86 species of fish and 41 species of mollusks, with 7 fish species and 6 mollusk species on the Ohio endangered species list. Both creeks have been designated as State and Federal Scenic Rivers. Located in west-central Ohio, the Big Darby Creek Watershed consists of 86 miles of main stem river and 245 miles of tributaries. The watershed drains 557 square miles from six counties in central Ohio.

About eighty percent of the watershed is farmland, and local farming has subjected the watershed to both point source and nonpoint source pollution. Residential land uses and stress from the conversion of agricultural land to urban and suburban development have negatively impacted water quality by increasing sedimentation and nutrient runoff. The decrease in water quality poses a threat to the watershed's aquatic species and biological diversity.

Protecting Wildlife and Endangered Species

In response, local citizens have organized action groups like the Darby Partners, a partnership consisting of more than 40 private and public organizations. Over 2,900 people have been involved and 284 local farms are working to reduce sediment and nutrient runoff. The Ohio Department of Natural Resources, The Nature Conservancy and other stakeholders have identified Big Darby Creek as a high priority area and are developing a

Big and Little Darby Creeks are home to 86 species of fish and 41 species of mollusks, with 7 fish species and 6 mollusk species on the Ohio endangered species list

long-term management and protection plan for the river and riparian areas. Ohio EPA and U.S. EPA's Office of Water and Office of Research and Development are leading an ecological risk assessment case study to guide future development and land use.

Stakeholders in the Big Darby Creek Watershed have supported numerous activities to reduce the effects of agriculture and development-related pollution. Several projects involved the installation and monitoring of best management practices. Other projects studied stormwater in rapidly growing areas of the watershed and funded the compilation of a Geographic Information System (GIS) database that identifies erodible lands and the benefits of conservation practices. Educational programs taught residents and county officials new technologies and conservation practices.

Monitoring and evaluation by Ohio EPA and U.S. Geological Survey have revealed remarkable improvements in the Big Darby Creek Watershed. A USDA project that encouraged conservation tillage and increased critical area seedings is credited with sediment reduction of 35,500 tons and gross erosion reduction of over 400,000 tons. Eighteen new wetlands have been created, 312 acres of trees have been planted and over 32,000 acres are now in conservation tillage. The removal of two dams has permitted the upstream migration of native species.

State and Federal Partners

These local initiatives are financially supported by the federal government, State of Ohio, City of Columbus, Ohio State University, The Nature Conservancy and the Soil and Water Conservation Districts in Champaign, Franklin, Logan, Madison, Pickaway and Union Counties. State government partners include the Department of Natural Resources, Ohio EPA, Mid-Ohio Regional Planning Commission and Ohio State University Cooperative Extension Service. Federal partners include the USDA Natural Resources Conservation Service, USDA Farm Services Agency, EPA, DOI Fish and Wildlife Service and DOI Geological Survey.

The Conemaugh River Watershed

Innovative Solutions for Acid Mine Drainage

Designated as the State River of the Year by the Governor of Pennsylvania, the Conemaugh River is located in Cambria and Somerset Counties, Pennsylvania. The Conemaugh River Watershed covers 1,361 square miles in the Allegheny Mountains of western Pennsylvania and contains forest, agricultural and urban habitats.

The Conemaugh River Watershed is highly polluted by acid mine drainage (AMD) from over 150 years of regional coal mining. Two independent river basin studies identified more than 250 separate sources of AMD. The watershed also suffers from excessive nitrate concentrations of public surface and groundwater supplies. It is listed as a Priority 1-A watershed in Pennsylvania's Unified Watershed Assessment.

Getting to Work on AMD

The Stonycreek & Conemaugh Rivers Improvement Project (SCRIP) is a broad coalition of individual volunteers, local organizations, county, regional, state and federal agencies and universities committed to restoration of the watershed. The extensive, locally-based partnership uses a wide variety of programs and has undertaken multiple projects that work to mitigate the effects of AMD. To ensure that the programs are effective, SCRIP's Riverkeeper project works with the US Geological Survey to assess these programs and monitor the watershed for new AMD discharges.

SCRIP remediation projects often employ passive treatment technologies. For example, one project, with assistance from the USDA Natural Resources Conservation Service, constructed a passive wetland system on Bear Rock Run which treated 100 gallon per minute (gpm) drainage from an abandoned mine with a shallow oxidation basin, two organic substrate ponds and a limestone pond. The project also involved streambank restoration and creation of a 3-mile walking trail. A SCRIP project at the Hillman Mine maximized retention and deposition time of the 3,500 gpm discharge flow with newly established vegetation, serpentine rock-lined channels and two settlement ponds. Finally, the Manganese Reclamation Ecology Team at Shade Creek installed two anoxic limestone drains, two in-line limestone cells, two in-line wetlands and five in-line ponds to mitigate the impact of AMD.

Acid Mine Drainage & ART Program

One of the Conemaugh River Watershed restoration efforts, the

AMD & ART Program, works with many partners, such as the US Forest Service, and receives financial assistance from an EPA Sustainable Development Grant. The program blends innovative science and technology with cost-efficient, low maintenance landscape designs that promote community participation, awareness and education. More than 10 percent of the local community assisted in the development of the 35-acre Vintondale remediation site, which borders the Ghost Town Rail Trail, host to approximately 70,000 users annually. The site combines AMD treatment and historical information on a series of interpretive trails. Another project, in the Central City and Dark Shade Creek Sub-basin, contains more than 20 AMD discharges and received the first EPA Brownfields loan given to a coal valley. The Brownfields Assessment in the sub-watershed will determine how regional AMD and industrial sites can be reclaimed for development.

Stream Team Project

The Stream Team Project is a model monitoring program developed in the Conemaugh River Basin. When two AmeriCorps members linked the existing monitoring groups, they created a stream monitoring network that involves high school and college students, senior citizens and working individuals. With an estimated 200 volunteers covering 100 stream

The Governor of Pennsylvania has designated the Conemaugh River as the State River of the Year

sites across six sub-watersheds, the network is thriving and provides reliable water quality data. Pennsylvania Department of Environmental Protection laboratories analyze the samples for metals and related pollutants; the resulting data are then used in AMD discharge remediation planning.

Looking Forward

Significant results have already been achieved along the Conemaugh River. Fisheries have been reestablished. A local water supply has been restored. Well-attended events, such as the Stonycreek Kayak Rendezvous, which drew 500 people, indicate that recreational use of the watershed has also been reestablished.

Future SCRIP endeavors will build upon past successes. A feasibility study has already been completed for a project involving the St. Michael mine shaft, which is responsible for almost 30 percent of the pollutant load in the watershed. The shaft's 2,500 gpm supply of water and surrounding topography would allow the utilization of a pump storage system to generate electricity during peak demand times. Such innovation characterizes SCRIP and its work in the Conemaugh River Watershed.

State and Federal Partners

The SCRIP partnership receives financial support from the federal government, State of Pennsylvania, Cambria County Conservation and Recreation Authority, Cambria County Conservation District, Somerset County Conservation District, Canaan Valley Institute, Captain Planet Foundation and a private Somerset County nonprofit corporation. Partner organizations in state government include the Department of Environmental Protection, Department of Conservation and Natural Resources and Pennsylvania State University School of Forest Resources. Federal partners include the US Army Corps of Engineers, Americorps, EPA, DOI Office of Surface Mining, DOI Geological Survey and USDA Natural Resources Conservation Service.

The Guest River Watershed

River Restoration in an Appalachian Watershed

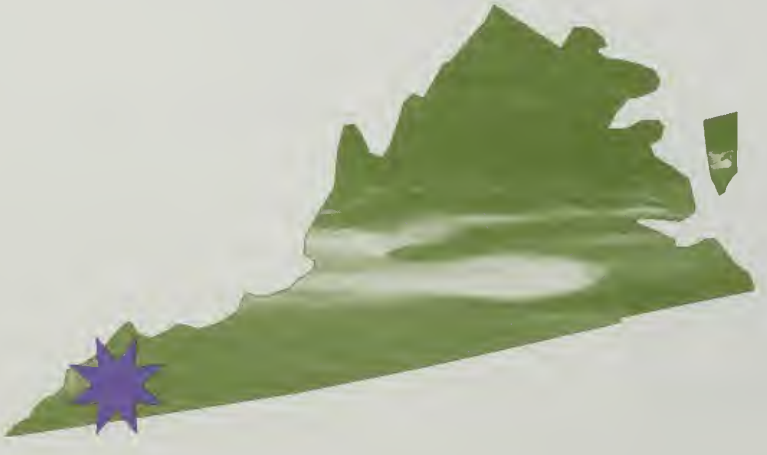
The Guest River Watershed is in the seven-county Coalfields Region of southwest Virginia and lies within the Appalachian Plateaus Province. The watershed drains approximately 100 square miles in Wise County, Virginia. The Clean Water Action Plan partners recognized the accomplishments in restoration in the watershed by designating it a National Case Study Watershed.

The Guest River Watershed is typical of many coal-impacted watersheds in the Central Appalachians. Abandoned mine lands have caused excessive erosion, decreasing vegetative cover that is the watershed's natural riparian habitat. An extensive Tennessee Valley Authority monitoring program, carried out from 1994 through 1997, indicated that untreated wastewater discharge, past mining operations and urban runoff all contribute to the low level of water quality in the Guest River.

Using Stream Corridor Restoration Technology

In 1995, the formation of the Guest River Group, an informal alliance of watershed residents and over 15 local, state and federal agencies, sparked interest in protection and restoration of the Guest River Watershed and led to the development of an integrated remediation plan for the entire watershed. The plan addresses a variety of water pollution sources, including fecal coliform bacteria, sedimentation, hazardous wastes and urban nonpoint source runoff.

A primary goal of the Guest River Restoration Project is to reduce sedimentation and erosion levels through the application of stream corridor restoration technology. Many different techniques have been used for stream restoration and streambank stabilization. Banks have been sloped to open channels and lower instream flow. Log sills and check dams have been installed to maintain mid-channel flow, reduce flow energy and improve aquatic habitat upstream. Erosion control fabric placements and cedar tree revetments have protected and narrowed stream width. A tree give-away program and tree and shrub plantings have complemented the creation of a vegetated riparian buffer zone. Actions to date have protected more than six miles of streambanks.



Pollutant Mitigation in the Guest River

The accomplishments of pollutant mitigation and management actions undertaken as part of the Guest River Restoration Project are also already apparent. Bacterial levels in the river have been lowered due to the elimination of 33 residential straight pipes and the pumpout of 400 residential septic tanks. Hazardous waste pollution has been reduced through a no-penalty collection program, reclamation of three abandoned mine lands, cleanup of 11 illegal dump sites and removal of 234 tons of material.

The Clean Water Action Plan partners recognized the accomplishments in restoration in the watershed by designating it a National Case Study Watershed

Several activities have increased public awareness of the Guest River Watershed Project. The towns of Coeburn, Norton, Apalachia and Wise participated in an urban storm drain stenciling program. An outdoor classroom was created for area school children, and over 2,500 students have been reached through education days and enviro-scape presentations. Project partners also published a 12-page supplement to the Coalfield Progress, a local newspaper, and distributed 4,000 informative placemats to local restaurants.

The Guest River Group continues to design and implement best management practices to reduce urban runoff and control sedimentation and erosion. Project partners have installed individual treatment systems at seven homes which currently discharge wastewater directly into the river and plan to install similar systems at two more homes. More dumpsite cleanups are planned, and an innovative white goods program will be initiated to protect streams by removing appliances that have the potential to contain harmful pollutants.

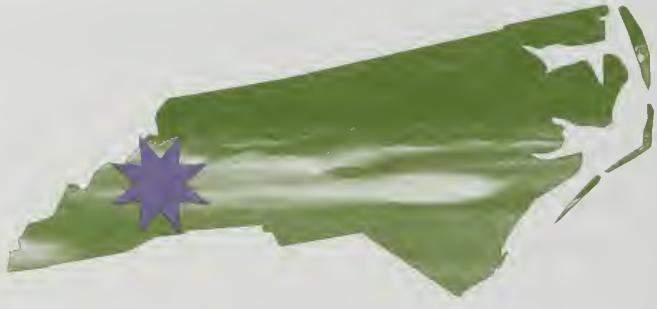
State and Federal Partners

The Guest River Watershed Project receives financial support from the federal government and the State of Virginia; local coordination is provided by the Lonesome Pine Soil and Water Conservation District. State partners include the Department of Forestry and the Department of Game and Inland Fisheries. Federal partners in the Guest River Restoration Project include the Tennessee Valley Authority, USDA Natural Resources Conservation Service and USDA Forest Service.

The Oconaluftee and Ravens Fork Rivers Watershed

Restoring Rivers and Riparian Areas Through Innovative Actions

The Oconaluftee and Ravens Fork Rivers flow through the lands of the Eastern Band of the Cherokee Indians in a region of western North Carolina that borders the Great Smoky Mountains National Park. The rivers and nearby Soco Creek are part of 30 miles of trout streams commercially managed by the Cherokee Tribe.



The watershed is a popular area for tourists and is also an important source of revenue for local communities, especially the Cherokee Tribe. The negative impacts of development, recreation and urbanization in the watershed have led to increased erosion, sedimentation and habitat degradation. Historic gravel dredging has also affected one reach of stream in the watershed by causing a 19-foot vertical incision in the channel wall.

The rivers and nearby Soco Creek are part of 30 miles of trout streams commercially managed by the Cherokee Tribe

The Federal-Tribal Partnership

In 1999, the former Principal Chief of the Cherokee Tribe initiated the formation of a partnership with EPA and USDA Natural Resources Conservation Service. New partners, such as the Bureau of Indian Affairs, have also joined the watershed effort. The partners' objectives are two-fold: plan, design and implement best management practices (BMPs) for stream restoration and build greater awareness of watershed protection techniques among area landowners. By 1998, work had begun on restoration projects and on drafts of an Erosion Control Ordinance and an Integrated Resource Management Plan.

Fluvial Geomorphology

The stream restoration projects utilize the basic principles of fluvial geomorphology, a technique that adapts natural river dynamics for stream restoration. For example, constructed rock vanes reduce the rate of stream flow by deflecting higher velocities away from the bank to the center of the channel. This deflection promotes sediment deposition near the streambank and has transformed several erosional streambanks into depositional streambanks. Plantings of native vegetation, such as mountain laurel and maple, reinforce the effects of

the rock vanes by slowing flood velocities, stabilizing streambank soils and creating buffer zones.

The restoration of Soco Creek involved a "marriage" of classic engineering and fluvial geomorphology. The project included channel reconstruction, installation of rock vanes in the lower portions of channel and installation of gabion baskets, a type of channel wall support structure, in the portions of the channel higher than normal flood flows. Project participants worked on a 300-foot stream channel by comparing it to a healthy upstream section. Similar widths, depths, meanders, slopes and pool spacings were reconstructed based on the upstream section. The structures secure a farmer's barn from collapsing into the stream, and the channel reconstruction provides a naturally stable channel and floodplain.

Restoration activities on the Oconaluftee and Ravens Fork Rivers and Soco Creek have already yielded significant improvements. Nine hundred feet of streambank have been stabilized and 900 feet of riparian areas have been replanted. An additional two thousand feet of channel are being redesigned using natural techniques, and an additional 4,000 feet of riparian areas are being replanted. Also, project partners plan to work with the Natural Resources Conservation Service Plant Materials Center to restore and protect culturally important native riparian vegetation, such as the river cane used by the Cherokee Tribe in basket weaving.

State and Federal Partners

The Oconaluftee and Ravens Fork Rivers restoration projects receive financial support from the federal government, State of North Carolina, Wildlife Federation and Eastern Band of the Cherokee Indians, and local support through the Swain County Soil and Water Conservation District. Partners in state government include the North Carolina State University Cooperative Extension Service and Western Carolina University. Federal support comes from the Department of Energy, Tennessee Valley Authority, EPA, DOI Bureau of Indian Affairs, DOI Fish and Wildlife Service and USDA Natural Resources Conservation Service.

Building Upon Success

Educational outreach and monitoring projects complement the BMPs. A partnership between Western Carolina University and Tennessee Valley Authority is organizing the collection and analysis of sedimentation data in the watershed. This monitoring will determine portions of the watershed most in need of restoration and BMP implementation. While monitoring efforts assess project effectiveness, educational outreach programs display projects and enhance public awareness of restoration activities. For instance, tours for interested parties, such as landowner associations, have exhibited actions taken and planned. Newsletters, articles and conferences have also increased public awareness of the watershed-wide effort. Through BMPs, education and monitoring, stakeholders hope to continue improving the watershed and preserve the essential trout habitat.

The Bigalk Creek Watershed

Eliminate the Sediment and Erosion; Bring Back the Fish

The Bigalk Creek, a spring-fed, coldwater tributary of the Upper Iowa River in northeast Iowa, has a unique limestone bedrock that provides some of the most spectacular and fragile surface waters in the state. The Howard County watershed is six miles long and encompasses 11,600 acres within the Upper Iowa Watershed, which contains 14 lakes and 1,429 miles of river.

Land located above the trout stream in the Bigalk Creek Watershed is used predominantly for agriculture. In recent years, uncontrolled livestock access to the creek has significantly diminished the fish population. Livestock overgrazing, sedimentation and streambank erosion have degraded pool habitat and reduced instream vegetation. Also, the creek's geological composition, fractured limestone bedrock covered by a thin layer of soil, potentially allows agricultural inputs such as fertilizers, pesticides and manure to leach through the soil and contaminate groundwater. The USDA Natural Resources Conservation Service classifies all of the cropland near the fishable section of the stream corridor as highly erodible, with a high potential for sediment to reach the stream channel.

Landowners Take the Initiative

In 1992, landowners in the watershed joined with federal, state and local agencies to create the Bigalk Creek Water Quality Project. The project has five goals: to create awareness of fertilizer and pesticide use impacts, to demonstrate the feasibility of several innovative resource management systems, to reduce streambank erosion, to reduce sedimentation and to reduce the amount of livestock manure reaching the stream.

Landowners' restoration efforts near the trout stream have included tree plantings, implementation of streambank stabilization measures, construction of a cattle crossing, installation of fish habitat structures and utilization of innovative nose pumps for livestock watering. Farmers have also erected permanent fencing, including a solar-powered electric fence, to limit cattle access to the stream system. Upland management practices to control runoff have included construction of sediment basins, implementation of no-till and strip-cropping farming systems and establish-

ment of contours and grassed waterways.

Governmental agencies have supported local actions with their own initiatives to restore the stream corridor. The USDA Conservation Reserve Program has worked with landowners to install riparian buffers and filter strips along the stream. The Iowa Department of Natural Resources (DNR) and the Department of Agriculture and Land Stewardship Division of Soil Conservation have contributed technical expertise and funding to reshape the streambanks, construct fish hides, re-seed vegetation in the area and install rock riprap, a combination of various materials, such as concrete blocks and rubble, intended to prevent flooding and erosion.

The Trout Return

The extensive effort made in Bigalk Creek has enjoyed tremendous success. A July 1999 DNR creek survey counted 80 rainbow trout, representing a 600 percent increase from an identical 1992 survey. The same survey noted that 20 percent of the fish were naturalized—they had been in the stream long enough to acquire their natural coloring or were naturally reproduced. The results make the Bigalk Creek only the third stream in Iowa with documented natural rainbow trout reproduction. A follow-up survey in October 1999 documented 150 naturalized rainbow trout per mile of stream, the highest number of wild rainbow trout ever documented in an Iowa trout stream. The surveys also detected the presence of invertebrates, another key indicator of stream health.

A survey counted 80 rainbow trout, representing a 600 percent increase from an identical 1992 survey

The Bigalk Creek Water Quality Project has surpassed many of its original goals. Sediment delivered to the stream has been reduced by 50 percent. The creek's annual sediment load from erosion has deceased by 5,000 tons—a 60 percent reduction. Livestock manure reaching the stream has been reduced by 50 percent. These reductions have brought about a noticeable improvement in water quality and slowed algal growth.

More Progress to Come

Landowners have found best management practices to be both ecologically and economically rewarding, and future use of BMPs should continue improvement of Bigalk Creek's water quality and fish habitat. A 1998 effort, the Bigalk to Bohemian Water Quality Project, will use integrated crop management techniques to further reduce the potential for agricultural contaminants to leach into water resources. Targeting 83,000 acres in Howard County, the project has shifted the emphasis of restoration efforts from surface water to groundwater concerns.

State and Federal Partners

Restoration activities in the Bigalk Creek receive financial support from the federal government and the State of Iowa. Local leadership and administration of the Bigalk Creek Water Quality Project is provided by the Howard County Soil and Water Conservation District. Partners in state government include the Department of Natural Resources, Department of Agriculture and Land Stewardship and Iowa State University Cooperative Extension Service. Federal partners include the EPA, USDA Farm Services Agency and USDA Natural Resources Conservation Service.

The Illinois River Watershed

Demonstrating Stream Restoration and Land Management

The Illinois River Watershed comprises approximately 200,000 acres in 54 counties in the State of Illinois, a region representing 90 percent of the state's population. 327 miles in length, the Illinois Waterway flows from nine smaller rivers and Lake Michigan to the Mississippi River, near St. Louis, and contains 11,061 miles of streams. Certain aspects of the watershed, such as its "flood pulse" or natural seasonal water level fluctuations, create optimal conditions for aquatic and terrestial wildlife habitat; the Natural Heritage Biological and Conservation Database lists occurrences of 1,286 aquatic organisms and 744 terrestrial species.

The watershed includes rural, urban and forest ecosystems but is used primarily for fishing, recreation and wildlife habitat. Human impacts, such as agricultural and industrial runoff and stream channelization, have impaired the watershed by altering the natural stream flow and generating excessive levels of nutrients, siltation, metals, suspended solids and organic enrichment. The annual deposition of 8 million tons of sediment in the river has virtually filled over 50 lakes and greatly impairs the river's functionality. In 1992, the National Research Council named the Illinois River Watershed as a restoration priority - one of only three river-floodplain ecosystems selected. The Illinois River Basin contains 124 waterbody segments and 71 lakes on the state's List of Impaired Waters and 32 Unified Watershed Assessment Category 1 watersheds.

150 Partners in Restoration

Several different programs are involved in the restoration of the Illinois River Watershed. They include the US Army Corps of Engineers Illinois River Ecosystem Restoration Study, USDA-State of Illinois Conservation Reserve Enhancement Program (CREP), US EPA-Illinois EPA Nonpoint Source Control Program and Illinois Conservation 2000 Streambank Stabilization Program.

These programs are coordinated by the Integrated Management Plan for the Illinois River Watershed (IMPIRW), developed in 1997 after a year-long effort involving 150 partners. The plan's objectives include stream restoration, water quality improvement, habitat preservation and support and protection of the regional economy. The plan hopes to attain these goals through restoration, monitoring, public outreach and public education actions. Its 34 recommendations for restoration focus on

dechannelization, streambank stabilization, runoff, erosion and sedimentation reduction, wetland construction and development of cost-effective, voluntary best management practice (BMP) programs.

Implementing the 34 Recommendations

Many projects have already been completed; many are ongoing or planned. Stream corridor restoration projects are applying such new and innovative technologies as rock riffles—instream structures that reduce water velocity and create slackwater areas—and bendway weirs—upstream-angled low-elevation stone sills designed to control and redirect currents and velocities throughout a stream bend. Four pilot watersheds across Illinois are implementing restoration techniques in collaboration with "control" watersheds to determine the effectiveness of the BMPs. One of the pilot watersheds is Court Creek, a sub-watershed of Illinois River Basin. Sixty-six ambient water quality monitoring stations and 947 intensive survey sites support these restoration activities by gathering and analyzing data.

The success of the actions in the Illinois River Watershed is exemplified by the success of the Conservation Reserve Enhancement Program. This voluntary program began accepting applications in May 1998. As of January 2000, 2,088 watershed landowners had enrolled 42,551 acres in the program, and 1,741 acres were in the enrollment process.

As of January 2000, 2,088 watershed landowners had enrolled 42,551 acres in the Conservation Reserve Enhancement Program, and 1,741 acres were in the enrollment process

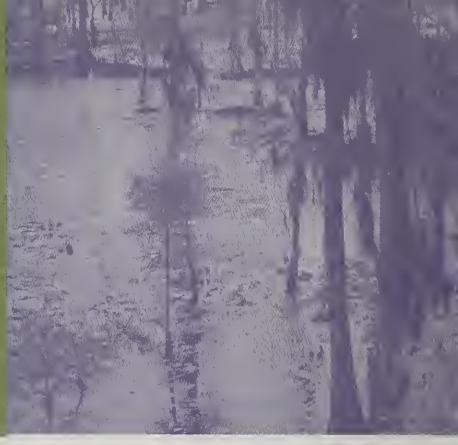
Public outreach and education projects have played a significant role in supporting watershed activities. BMP demonstration projects have been completed in 33 of the watershed's 54 counties. Over 10,000 copies of the IMPIRW have been distributed. Meetings, conferences, field trips and reports all enhance public awareness and participation.

The watershed-wide restoration effort is already producing results. Most notably, fish species absent from the river since 1908 have returned. Building upon past and current progress, the watershed partners will continue the restoration and preservation of the Illinois River Watershed.

State and Federal Partners

The Illinois River Watershed restoration effort receives financial support from the federal government, State of Illinois and McNight Foundation, with local support from county Soil and Water Conservation Districts. Partners in state government include the Department of Agriculture, Department of Natural Resources, Environmental Protection Agency, Department of Commerce and Community Affairs, State Geological Survey, State Water Survey and State Natural History Survey. Federal support comes from the US Army Corps of Engineers, USDA Farm Services Agency, USDA Natural Resources Conservation Service, EPA, DOI Fish and Wildlife Service, DOI Geological Survey and US Coast Guard.

The Tensas River Watershed



Reversing the Adverse Impacts of Agricultural Development

The Tensas River Watershed comprises 718,000 acres in Madison, Tensas, East Carroll and Franklin Parishes in Louisiana. The river flows approximately 315 miles, or 504 kilometers, through northeast Louisiana before emptying into the Black River.

Although 90 percent of the watershed was forested at one time, much of the Tensas River Basin has been cleared, drained and converted, and the watershed's land use is now 71.5 percent agriculture. The Tensas River Basin has approximately 65,000 acres of bottomland hardwood swamps remaining, most of which are located in the Tensas River National Wildlife Refuge and Big Lake Wildlife Management Area. The resulting loss of wetlands and riparian areas has contributed to water quality degradation, sedimentation, increased flooding and wildlife habitat and biodiversity losses. Suspected causes of river impairment include sediment, pesticides, organic enrichment and metals. The Tensas River fails to meet the state's dissolved oxygen standard, is listed as threatened in the state's 1998 Water Quality Assessment and is categorized as impaired in Louisiana's Unified Watershed Assessment.

Restoring Bottomland Habitat

Various federal and state agencies, nonprofit and special interest groups and local citizens formed a partnership to collaborate on restoration and research projects and work on a Watershed Restoration Action Strategy for the Tensas River. The Louisiana Department of Environmental Quality, EPA, The Nature Conservancy, USDA and other state and federal agencies used a holistic approach in developing a

The Partners for Fish and Wildlife Program has restored almost 4,000 acres of bottomland habitat and 15 miles of riparian areas

comprehensive protection plan for the watershed. The USDA Natural Resources Conservation Service, with assistance from the partnership's Technical Steering Committee, completed a River Basin Study. The resulting watershed strategy seeks to improve water quality and restore bottomland habitat through best management and conservation practices, educational outreach programs and monitoring projects.

Best management practices (BMP), erosion control structure installations and reforestation measures have been implemented through cost-share programs, such as USDA's Environmental Quality Incentives Program and Wetland Reserve Program and US Fish and Wildlife Service's Partners for Fish and Wildlife Program. The BMPs, including conservation tillage, precision agriculture, filter strips and nutrient and pesticide management practices, combat nonpoint source pollution and reduce the levels of agricultural chemicals and sediment entering the Tensas River. Educational outreach, which includes public meetings, workshops and publications, increases awareness of the various efforts taking place in the watershed, such as the BMPs, water quality Total Maximum Daily Load (TMDL) study, monitoring and sampling.

State and Federal Partners

The Tensas River Watershed receives financial support from the federal government, State of Louisiana and The Nature Conservancy, and the local support of the Tensas-Concordia, East Carroll, Northeast and East Carroll-Madison Soil and Water Conservation Districts. State government partners include the Department of Environmental Quality, Department of Agriculture and Forestry, Department of Health and Hospitals and Louisiana State University Cooperative Extension Service. Partner organizations in federal government include the USDA Natural Resources Conservation Service, EPA, DOI Fish and Wildlife Service and DOI Geological Survey.

Reforesting the Tensas River Watershed

The Tensas River Watershed projects are beginning to show an impact in arresting the environmental degradation of the watershed. For example, an estimated 56,000 acres of farmland have been reforested. Also, approximately 48,000 acres have been enrolled into the Wetland Reserve Program, and the Partners for Fish and Wildlife Program has restored almost 4,000 acres of bottomland habitat and 15 miles of riparian areas.

Current and future projects will augment this progress. For instance, a hardwood seedling nursery that grows over one million native seedlings annually will assist reforestation efforts. Several TMDLs

have been completed that, when achieved, will result in nonpoint source load reductions. A Tensas River trend station will improve monitoring and assessment capabilities. Educational programs now underway aim to increase local awareness and participation.

The Boulder and Upper Tenmile Creek Watersheds

Cleaning Up a Century of Hardrock Mining

Lands in the Boulder and Upper Tenmile Creek Watersheds in Montana have been mined since the nineteenth century. Principal metals extracted from this area included gold, silver, lead and zinc. Between 1902 and 1958, minerals extracted just in the Basin-Cataract Creek Mining District in the Boulder Watershed had an estimated value of $11 million.

The mining legacy, however, is the contamination and degradation of the watersheds' water resources. Metal-mining wastes and mill tailing deposits negatively impact water quality, riparian vegetation, human health and the overall environment. Streams are affected by the direct discharge of acid drainage from adits, seepage from tailings pipes and erosion of tailings.

The extensive partnership includes more than 20 landowners, local communities and numerous federal agencies

Basin and Upper Tenmile Creek Mining Areas

Efforts at mine cleanup in Montana are almost always initiated, organized and led by local stakeholders. Assistance from federal and state agencies supports the actions of the watershed residents. For example, cooperation was key to the success of clean-ups in the Upper Tenmile Creek Mining Area, located in the Rimini Mining District, which contains more than 20 abandoned mine sites. EPA and US Forest Service removed almost 40,000 cubic yards of mine waste from this Lewis and Clark County watershed in 1999, and watershed residents implemented streambank stabilization and fishery enhancement projects. In 1998 and 1999, locals planted nearly 5,000 indigenous riparian plants, trees and shrubs.

Similarly, in the Basin Mining Area of the Boulder River Watershed, community members are working with the EPA, US Forest Service, Bureau of Land Management and Montana Department of Environmental Quality to conduct a feasibility study and preliminary mining

waste removal actions. In 1999, EPA added the Basin and Upper Tenmile Creek Mining Areas to its Superfund National Priorities List.

Restoration of High Ore Creek

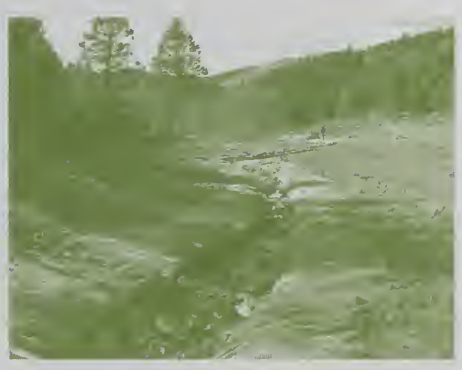
Environmental degradation in the Boulder River Mining Area has drawn together an extensive partnership in which local communities and more than 20 landowners are working with numerous federal agencies. Bureau of Land Management has already worked with the project partners to clean up seven sites. Thermal modification, habitat alterations, toxics, metals, siltation, suspended solids and turbidity all affect this region.

A glimpse of the massive restoration effort underway in the Boulder River Mining Area can be seen at High Ore Creek in Jefferson County, an area with 26 abandoned or inactive mine sites. Acid mine drainage from the Comet Mine has distributed 32,000 cubic yards of streamside tailings and 5,800 cubic yards of waste rock throughout the 3.7-mile High Ore Creek floodplain. In 1999, project partners cleared a six-acre repository, improved access roads and backfilled the floodplain with coversoil. The partners also constructed streambed including steps, pools and grade control structures and excavated, loaded and hauled streamside mine wastes. Moreover, they installed stream protection structures, silt fencing, willow fascines, bank stabilization fabric and erosion control mat. Finally, they reconstructed almost 3,500 linear feet of High Ore Creek and seeded and mulched stabilized streambanks.

The state constructed two toxic sediment settling ponds and put about 300,000 yards of mine tailings back into the original mine site. Bureau of Land Management relocated an additional 150,000 yards of material. The next phase will cover and reseed the site. More construction and restoration activities are planned to continue the amazing progress of 1999's projects.

State and Federal Partners

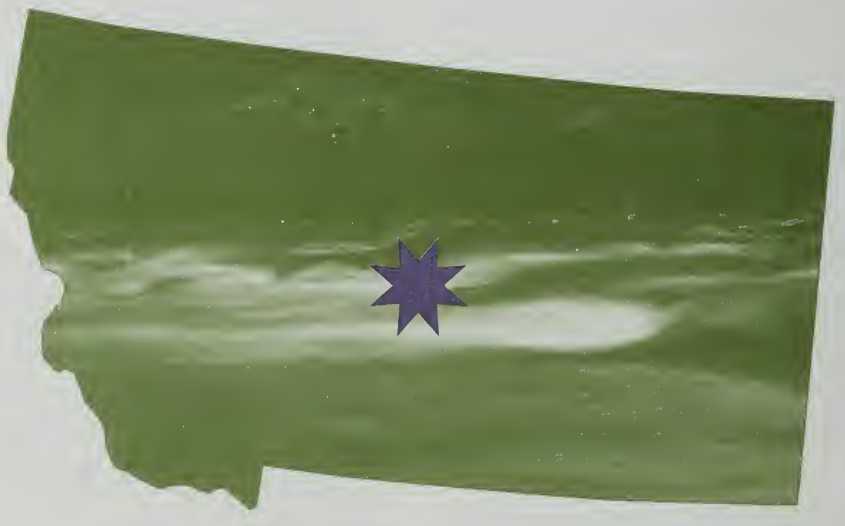
Mining cleanup and watershed restoration projects in Montana receive financial support from the federal government, State of Montana, Lewis and Clark Conservation District, Jefferson Conservation District and Walmart. Partners in state government include the Department of Environmental Quality, Department of Fish, Wildlife and Parks, Bureau of Mines and Geology, Department of Natural Resources and Conservation and State Conservation Corps. Federal partners include the USDA Forest Service, USDA Natural Resources Conservation Service, EPA, DOI Office of Surface Mining, DOI Bureau of Land Management, DOI Geological Survey, DOI Fish and Wildlife Service and US Army Corps of Engineers.



The Upper and Lower Bad River Watersheds

Addressing Water Quality through Land Management

The Upper and Lower Bad River Watersheds encompass more than 2 million acres, or 3,172 square miles, in the South Dakota Counties of Jackson, Jones, Haakon, Lyman and East Pennington. The Bad River converges with the Missouri River near Ft. Pierre. The river and its watersheds support an abundance of wildlife and aquatic species.



Land use in the Bad River Watersheds is primarily agricultural and consists of 75 percent rangeland and 25 percent dryland wheat farming. The soil and landscapes of the region make the land highly susceptible to both wind and water erosion. This erosion and season-long grazing practices that lead to the destruction of the riparian channels are the main causes of sedimentation and other forms of non-point source pollution in the watersheds. The river's annual sediment load of 3.25 million tons negatively affects the local sport fishing and recreation economy and leads to increased turbidity in the Missouri River, localized flooding and a reduction in power generation capacity at the Oahe Dam. The degraded water quality also impacts irrigated cropland, wildlife and fish habitats and the Lake Sharpe reservoir.

Land Treatment for Water Quality

Throughout the 1990s, area stakeholders have attempted to improve the Bad River and its watersheds, primarily through best management practices (BMPs), monitoring and education programs. BMPs in the region have sought to improve water quality, restore riparian areas and reduce polluted runoff. Many BMPs were implemented as demonstration projects to exhibit both the environmental and economic advantages to local stakeholders. Demonstration BMP projects were eligible for EPA Section 319 grants and USDA Environmental Quality Incentives Program cost-sharing of 30-70 percent of project costs.

Projects received technical assistance from USDA Natural Resources Conservation Service and involved planned grazing systems, proper grazing uses, erosion control structures, riparian revegetation, range seedings, water spreader systems and alternative stock watering facilities. One particularly innovative BMP helped preserve and restore riparian channel vegetation

with the installation of metal, wind-break fencing, which protects livestock and provides shelter without destroying the woody cover in the riparian area. Another innovative BMP constructed dual-purpose concrete access roads as stream crossings across eroding gullies. Removing livestock and other traffic from the waterways helped stabilize the streambanks, control erosion and restore natural grazing patterns.

An EPA National Monitoring Program project complements these BMP implementation projects. The monitoring project measures the impact of BMPs on water quality and compares the results with the results of a nearby control area that does not implement BMPs. BMPs were evaluated at locations in both the Upper and Lower Bad River Watersheds.

Success in the Bad River

The BMP, monitoring and education projects in the Bad River Watershed have brought about considerable progress. By some estimates, 45 percent of certain Bad River channels have been revegetated, and sedimentation reaching the Missouri River has been reduced by 30 percent. US Geological Survey data show that over the course of five years, the Plum Creek subwatershed's sediment per acre/foot of runoff dropped sharply from 82.7 tons to 10.2 tons. Improvements have been made on 90,000 acres of rangeland. No-till and mulch-till farming has been initiated on 4,084 acres of farmland.

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Nothing indicates this project's success more than the voluntary participation of local stakeholders. Landowner participation was exceedingly high throughout the watershed. Remarkably, in the Plum Creek subwatershed, 90 percent of the landowners, who hold title to 95 percent of the land area, have participated in the project.

State and Federal Partners

Projects in the Bad River Watershed receive financial support from the federal government, State of South Dakota, Jackson, Jones, Haakon, Lyman and Pennington Counties, their respective Conservation Districts and Resource Conservation and Development Councils, Pheasants Forever, Monsanto, Ducks Unlimited and Lower Brule Sioux, Oglala Sioux and Lakota Tribes. State partners include the Department of Environment and Natural Resources, Department of Game, Fish and Parks, Department of Agriculture and South Dakota State University Cooperative Extension Service. Federal support comes from the DOI Fish and Wildlife Service, DOI Bureau of Reclamation, DOI Geological Survey, US Army Corps of Engineers, EPA, USDA Forest Service, USDA Natural Resources Conservation Service and USDA Farm Services Agency.

The North Fork of the Ninnescah River Watershed

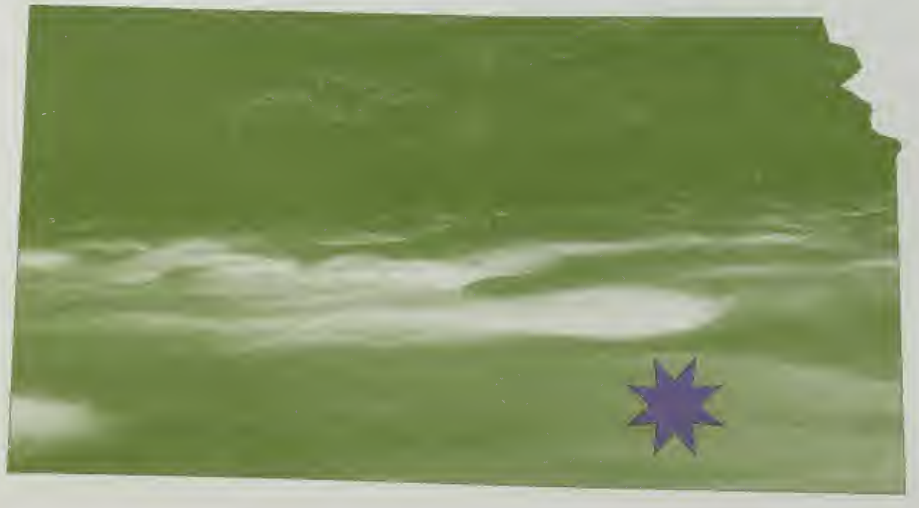
Working Together on Agricultural Best Management Practices

The North Fork of the Ninnescah River flows into the Cheney Reservoir in south-central Kansas and provides 40 to 60 percent of the City of Wichita's daily water supply. The North Fork of the Ninnescah River Watershed covers over 600,000 acres and encompasses land in Sedgwick, Reno, Kingman, Pratt and Stafford Counties in southeast Kansas. The watershed is diverse in terms of soil types, topography and rainfall.

The North Fork of the Ninnescah River Watershed is 99 percent agricultural, with a variety of farming and ranching practices. Sediment and other nonpoint source pollution from crops and livestock production are the main threats to water quality. Concentrations of animal waste and over-application or improper application of fertilizers and pesticides have created excessive levels of nutrients, especially phosphorous. The watershed is listed as a Category 1-A watershed in Kansas's Unified Watershed Assessment.

Agricultural Best Management Practices

In 1992, the Reno County Conservation District began to prepare a comprehensive management plan for the watershed. Implementation began in 1994 under the leadership of Citizen's Management Committee (CMC) of the Cheney Lake Water Quality Project, a rural-urban partnership representing local, state and federal agencies, local landowners and farmers and the City of Wichita. In 1995, the Kansas Rural Center joined the effort promoting and implementing sustainable farming and best management practices (BMP).



Implementation of BMPs to mitigate the impacts of agricultural pollution and sedimentation has occurred throughout the North Fork of the Ninnescah River Watershed. On-farm demonstrations, farm tours, educational workshops and farmer-to-farmer meetings have all encouraged and spread successful and innovative conservation practices. Agricultural BMPs used in the watershed include cover crops, filter strips, crop rotations, management-intensive grazing systems, strip cropping, center pivot irrigation, no-till planting techniques and animal waste systems, waterways and terraces. Seventeen percent of the land in the watershed is

enrolled in USDA's Conservation Reserve Program.

The Cheney Lake Water Quality Project uses innovative funding to encourage BMP implementation. Traditional cost-share programs, such as USDA's Environmental Quality Incentive Program, provide funds covering 50-70 percent of the cost for structural practices, thereby leaving some of the BMP financial burden with the landowner. In the North Fork of the Ninnescah River Watershed, the City of Wichita pays an additional 30 percent of the cost so that, in some cases, farmers do not incur any expenses for BMP installation. BMPs ineligible for cost-sharing can receive EPA Section 319 grants. BMPs and sustainable farming practices are credited with preventing 77,000 tons of manure from entering the watershed annually.

BMPs and sustainable farming practices are credited with preventing 77,000 tons of manure from entering the watershed annually

State and Federal Partners

The watershed project receives financial support from the federal government and the City of Wichita Water and Sewer Department, and local support from the Reno, Sedgwick Pratt, Kingman and Stafford County Conservation Districts. State support comes from the Department of Health and Environment, Department of Wildlife and Parks and Kansas State University Cooperative Extension Service. Federal partners include the USDA Farm Services Agency, USDA Natural Resources Conservation Service, EPA, DOI Geological Survey, DOI Bureau of Reclamation, DOI Fish and Wildlife Service and DOI National Park Service.

The Clear Creek Watershed

Saving a Natural Bayou

Clear Creek is a lushly forested bayou that meanders 40 miles from near the City of Friendswood, Texas to Clear Lake and Galveston Bay. Much like other bayous, Clear Creek provides extensive fish and wildlife habitat, purifies water and recharges aquifers. One of only four natural, unchannelized bayous in the City of Houston area, the creek is a nursery and feeding ground for more than 50 species of finfish, including redfish and flounder, and 3 species of shrimp.

Clear Creek is a vitally important and valuable watershed. Many of the species that spawn and feed in the watershed are important to the commercial fishing industry, and the area is a popular ecotourism and recreation destination. Unfortunately, human impacts including urban development, agriculture, and dredge and fill activities have degraded vital watershed habitats and water resources.

Protecting the Bayou

To reverse the trend of habitat and water resource degradation in the Clear Creek Watershed, the Galveston Bay Estuary Program, one of the 28 EPA estuary programs nationwide, included restoration of Clear Creek as one of its priorities in its Comprehensive Conservation and Management Plan (CCMP). The program builds consensus among citizens, business and industry, academia and government agencies and pools together resources, expertise and funding to

support innovative projects that involve local public and private partners.

Acknowledging that maintenance dredging is a necessary activity in the watershed, the Estuary Program sought to identify ways of making better use of the disposable material. A demonstration project constructed new wetlands with dredged material, thereby restoring valuable wetland habitats and enhancing the local environment by creating homes for fish and wildlife. The project dredged approximately 29,000 cubic yards of material and constructed a 12-acre containment dike. The material was then moved to a designated placement area behind the dike and was seeded with "Vermillion" smooth cordgrass. An additional 4.2 acres of wetlands were also created. The project received a 1999 Coastal America Partnership Award for its innovation and successful implementation.

Monitoring Bayou Restoration

Through water quality monitoring, watershed stakeholders identify and characterize watershed conditions and track the success of restoration efforts. The Clear Creek Surface Water Quality Monitoring Program conducts bacteria and metal analyses on a daily basis. Data from this program are recorded into a central database and distributed in monthly reports. The Texas Coastal Management Program also measures watershed conditions and enters the information into a Geographic Information System (GIS) database. Another project monitors storm sewers to detect illicit connections in the Clear Creek Watershed. These monitoring programs evaluate the effect of ongoing restoration efforts and will complement future restoration effort planning in Clear Creek.

State and Federal Partners

Clear Creek Watershed restoration efforts receive financial support from the federal government, State of Texas, City of Houston, Environmental Institute of Houston and Reliant Energy, and local support from the Harris Soil and Water Conservation District. State partners include the Texas Natural Resource Conservation Commission. Federal support comes from the DOI Fish and Wildlife Service, EPA and USDA Natural Resources Conservation Service.

The creek is a nursery and feeding ground for more than 50 species of finfish, including redfish and flounder, and 3 species of shrimp

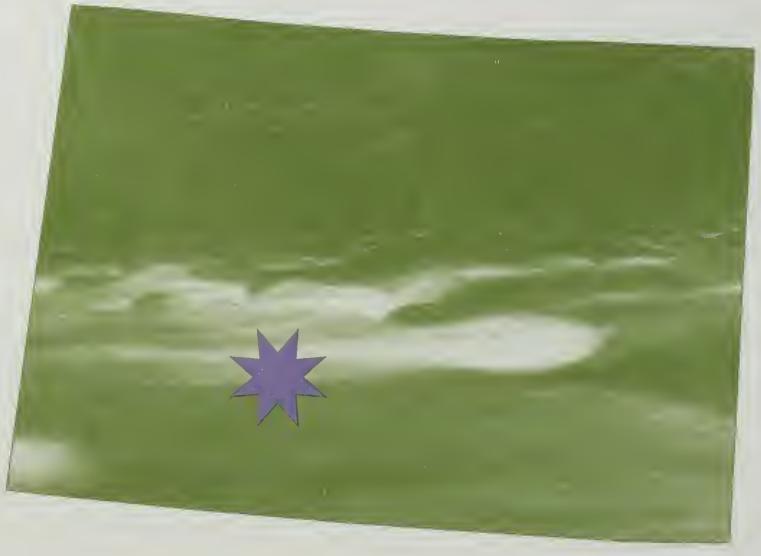
The Willow Creek Watershed

Planning the Mitigation of Mining Pollution

Between the 1890s and 1980s, Mineral County land in the State of Colorado was used for metal mining. Willow Creek, a headwater tributary to the Rio Grande River, is located near the Town of Creede in Mineral County. The Willow Creek Watershed consists of 35 square miles in the south-central part of the state.

Mine entrances opened in the mountains allowed water to flow through parts of the Creede District mines and mix with toxic substances. Mine waste piles throughout the creek also contributed to nonpoint source pollution. As a result, East and West Willow Creek contain levels of zinc, dissolved cadmium and lead well above state water quality standards. For example, in West Willow Creek, lead is found at 82 times the Colorado Table Value Standard. The State of Colorado's Nonpoint Source Assessment Report and Management Plan identifies the Willow Creek Watershed as a high priority area requiring nonpoint source metal control.

Local citizens and organizations have much expertise in evaluating the mining impacts to the Willow Creek Watershed



Planning Willow Creek Restoration

Contaminated water in the Willow Creek not only affects the chemical makeup of the waters in the Rio Grande River, but also negatively impacts the aesthetic and recreational values of the watershed. In late 1997, a coalition of over 35 local partners along with federal and state agencies formed the Willow Creek Reclamation Committee to address mine tailing pollution of the creek. This committee used an EPA Section 319 Nonpoint Source Management Grant through the State of Colorado to initiate a community-based approach to determine remediation needs and is in the process of drafting a long-term management program to improve

physical habitat and water quality in the watershed.

The committee compiled a list of goals and objectives for Willow Creek as a part of the watershed management plan to address nonpoint source pollution from mine adit discharges and mine tailings. The partners seek to avert fish kills in the Rio Grande River and improve water quality in Willow Creek. They also hope to improve the physical, chemical, biological and visual aspects of the watershed.

State and Federal Partners

The stakeholders in the Willow Creek Watershed receive financial support from the federal government and the State of Colorado, and local support through the Mineral County Soil and Water Conservation District. Partner organizations in state government include the Rio Grande Soil Conservation District, Cooperative Extension Service, Department of Minerals and Geology, Department of Natural Resources, Department of Water Resources, Department of Local Affairs, Department of Public Health and Environment and State Historical Society. Federal support comes from the USDA Forest Service, USDA Natural Resources Conservation Service, EPA, DOI Fish and Wildlife Survey, DOI Geological Survey, DOI Bureau of Land Management and US Army Corps of Engineers.

Assessing the Nonpoint Source Impact

Local citizens and organizations have much expertise in evaluating the mining impacts to the Willow Creek Watershed. In addition, numerous federal and state agencies are assisting the local partners in the planning phase of the Willow Creek Watershed restoration project. For example, the Army Corps of Engineers is planning to fix a flume through Creede, the USDA Natural Resources Conservation Service is designing stream-channel reconstruction and EPA and DOI are involved in sampling events. The Colorado Department of Minerals and Geology is in charge of controlling physical hazards to prevent future contaminant releases while preserving historic structures.

The US Forest Service is tracing contamination in groundwater, and the US Geological Survey is similarly tracing contamination in area streams. The outcome of the first dye tracing phase suggests that the contamination in Willow Creek may be confined to a limited area. This result indicates that the Willow Creek Watershed management plan may be technically and financially realistic. Once the Willow Creek committees finish their watershed characterization work and finalize their nonpoint source pollution abatement strategy, then actual restoration work will proceed.

The North Fork of the Gunnison River Watershed

Coordinating Community-Led Restoration

The North Fork of the Gunnison River Watershed consists of 986 square miles in the State of Colorado bounded on the north by Grand Mesa, McClure Pass and the Ragged Mountains and on the east and west by the Grand Mesa National Forest and the White River National Forest. The river flows 33 miles, through the Cities of Paonia and Hotchkiss, before flowing into the Gunnison River just north of the Black Canyon of the Gunnison National Park.

The watershed is characterized by a valley of multiple river terraces used for agricultural purposes. Channelization of the river has destabilized stream flows and the river bottom. The river is further impacted by grazing, logging, pesticide application, feed lot and highway runoff, coal and in-stream gravel mining, irrigation diversions and reservoir operations. As a result, the Colorado Department of Public Health and the Environment identified the North Fork watershed as a priority watershed in its 1998 Unified Watershed Assessment and a watershed restoration action strategy is being developed.

Community-Led Restoration

For years, restoration activities in the watershed were not coordinated and were usually carried out by individual landowners. These single-handed efforts were rarely successful, and often caused problems for nearby landowners. However, in 1996, landowners, water users, government agencies and concerned citizens formed the North Fork River Improvement Association (NFRIA). This association has sought to meet usage demands on the river while improving stream stability, riparian habitat and ecosystem function.

NFRIA supports long-term, cost-effective projects that improve water quality, channel stability and riparian habitat, divert irrigation water, increase in-stream flows and reduce ditch maintenance. For example, in 1999, 20 acres of wetlands were created, 2,500 feet of streambank were stabilized and work on 100 acres of conservation easements was completed. The University of Colorado-Denver has recognized NFRIA for its consensus building and collaborative decision-making efforts related to local sustainable development policies.

Moving Forward

The North Fork's watershed-wide coordination has increased stakeholder involvement in restoration activities and has greatly increased the number of efforts underway in the region. The North Fork Irrigation Diversion Demonstration Program, a project on 1.5 miles of the North Fork channel floodplain, highlights the innovation of these activities. Constructed in the winter of 2000, the demonstration project restored meanders to the reach and employed a wide range of bio-engineering treatments to stabilize banks and enhance wetlands. An irrigation diversion was also reconstructed to eliminate the need for annual "push-up" gravel diversion dams. High school students assist in project revegetation work and document project progress on video.

20 acres of wetlands were created, 2,500 feet of streambank were stabilized and work on 100 acres of conservation easements was completed

NFRIA studies in the watershed will collect the data necessary for continued restoration. One study is being led by the Colorado State University and is researching the impact of the Paonia Reservoir on restoration efforts downstream. The study is also examining the rate at which silt is settling in and filling up the reservoir.

State and Federal Partners

NFRIA projects receive financial assistance from numerous sources including the federal government and the State of Colorado. Partners in state government include the Delta Soil Conservation District, Department of Transportation, Department of Natural Resources, State Water Conservation Board and Colorado State University. Federal partners include the USDA Natural Resources Conservation Service, USDA Forest Service, USDA Farm Services Agency, EPA, DOI National Park Service, DOI Geological Survey, DOI Bureau of Reclamation, DOI Fish and Wildlife Service and US Army Corps of Engineers.

The San Miguel River Watershed

Comprehensive Watershed Management in Action

The San Miguel River Watershed in southwest Colorado extends 72 miles from high alpine meadows and waterfalls above Telluride to a sandstone canyon confluence with the Dolores River. The one million acre watershed drops over 7,000 feet between the alpine and desert ecosystems. With 33 different landscape types found in the 18 headwater basins, and with many rare plant and animal communities, the San Miguel River Watershed includes some of the most biologically intact and valuable landscapes in the nation.

Land use in the watershed includes agriculture, mining, resort tourism and recreation. These uses and the related regional development and growth have negatively impacted the San Miguel River Watershed. Large-scale development is one possible cause of both excessive nutrient levels and concentrated flows of runoff, which lead to heavy sedimentation and erosion. Consistent with increases in development, population increases have resulted in the over-appropriation of water and reduction of instream flows. Separately, on-site gravel mining and historical mining runoff have contaminated surface water, contributed to a lack of riverside vegetation and limited essential wildlife habitat. Channelization and stormwater runoff also affect the San Miguel River Watershed.

Protecting the San Miguel River Watershed

Efforts to coordinate restoration activities in the San Miguel Watershed began in 1990. In 1994, the San Miguel Watershed Coalition was formed, led by the Rivers and Trails Program of the National Park Service and the Telluride Institute. Numerous studies, including rare plant and animal surveys, instream flow studies, a fish survey, a land health assessment, a hazardous waste inventory, water quality studies and ongoing river restoration studies determined the condition of the watershed. The broad coalition of over 20 participating entities utilized information from the studies and public meetings to draft a management plan to conserve and enhance the natural, cultural, recreational, social and economic resources of the watershed.

Many different kinds of restoration projects have been implemented in the San Miguel River Watershed. In 1998, the San Miguel Planning Commission sought to amend local land use codes to protect headwater catchments from further development and degradation. This action led to the San Miguel Board of County Commissioners' legal adoption of stipulations on construction, sewage disposal, fertilizer use, blasting and new roads. Combined with Geographic Information System (GIS) mapping and modeling and the development of sourcewater protection programs, these stipulations earned San Miguel County an EPA Outstanding Achievement Award and a National Association of Counties Award for community-based ecosystem protection.

Several other projects focus on limiting the impact of recreational and tourism-related watershed uses. The Bureau of Land Management, with assistance from the Forest Service, has introduced a designation system for area campgrounds and trails. Eleven sites have been closed to camping and vehicles, and educational posts and bulletin boards will explain the importance of the closures for habitat protection and preservation. A new map will display sites available for recreational purposes. Some open sites, such as the Jud Wiebe trail, will be reconstructed or improved to enhance the outdoors experience. The Bureau also lifted a moratorium on commercial river outfitting to increase the recreational options in the watershed.

The San Miguel Watershed Coalition also works on more traditional watershed restoration activities, such as streambank stabilization, acid mine drainage mitigation and land acquisition. For example, the Town of Telluride will begin construction on a section of the San Miguel River to restore aquatic, wetland and riparian habitat, improve river hydraulics and mitigate sediment impact in the channel. The project has completed construction of a wetland that is part of a drainage system designed to filter runoff from 40 percent of the town streets. Also, four projects in the Mountain Village area involve stream and wetland restoration, native material planting and construction of aquatic benches, shallow areas that support submerged and emergent aquatic vegetation. Near Nucla, approximately 160 acres of roller chopping, which stimulates forage plant growth by removing older trees and shrubs, and revegetation improved winter range for watershed animals and supported the weed control efforts of the local community.

Successful watershed projects earned San Miguel County very distinguished awards

The coalition has used local stewardship and involvement to the benefit of the watershed restoration plan. The partners support numerous public outreach activities. One project, the San Miguel Watershed Education Project, seeks to include younger stakeholders. This project, with participants from all three of the watershed's school districts, sponsors educational field trips to "Living Classroom" sites. At these sites, the project's interdisciplinary curriculum covers geology, water quality testing, river dynamics, nature writing, mining history, dam exploration and other topics.

Past, Current and Future Success

The San Miguel Watershed Coalition's efforts have already protected over 10,000 acres of alpine wetlands and headwaters. New projects, such as Community Based Environmental Protection pilot sourcewater protection programs developed by seven communities, will continue the regional protection and preservation. The extensive locally-based partnership will help sustain past progress and enhance stewardship in the watershed.

State and Federal Partners

The San Miguel Watershed Coalition receives financial support from the federal government, State of Colorado, County of San Miguel, Natural Resource Damage Funds, Telluride Company, Great Outdoors Colorado and Telluride Institute. The coalition also receives proceeds from a VISA credit card, issued by San Miguel County Open Space Commission, Conservation Foundation and Telluride Visitor Services. Partners in state government include the San Miguel Soil Conservation District, Cooperative Extension Service, Department of Public Health and Environment, Water Conservation Board, Department of Natural Resources and Department of Local Affairs. Federal partners include the DOI National Park Service, DOI Bureau of Land Management, DOI Geological Survey, EPA, USDA Forest Service and USDA Natural Resources Conservation Service.

The Little Colorado River Watershed

Multi-Objective Management of Human Impacts

Most of the over 26,000 square miles of land in the Little Colorado River Watershed is rural, with almost half in Indian Nation lands. Bounded by the basins of the Rio Grande, Gila, Salt, San Juan and Colorado rivers, the watershed consists of 17 sub-basins and covers vast parts of northeast Arizona and northwest New Mexico. The main stem of the Little Colorado River begins near Springerville, Arizona, in the White Mountains and flows nearly 350 miles before emptying into the Colorado River in Grand Canyon National Park, where it provides a major source of sediment for Canyon beaches.

Land uses include ranching, timber harvesting, agriculture, mining, power generation, tourism and recreation. These activities, most notably mining and agriculture, have caused surface water contamination, high turbidity levels, flooding and excessive sedimentation and erosion.

The Multi-Objective Management Plan

In 1996, in response to continued flooding threats to the communities of Winslow and Holbrook, Navajo County, with assistance from the Army Corps of Engineers' Task Force Based Floodplain Management Assistance initiative, sponsored a workshop to focus on watershed management and address stakeholder concerns. That workshop, held in 1997, and another workshop held that same year organized a locally-led planning effort under the Little Colorado River Plateau Resource Conservation and Development Area, Inc., a rural development, non-profit organization. Community leaders agreed to address issues through the use of a multi-objective management approach, which simultaneously addresses all of a watershed's problems.

The Little Colorado River Watershed Partnership provides an opportunity for citizens, businesses, and communities to establish a voluntary collaborative approach to enhancement of the quality of life in the watershed. The partnership seeks to accomplish this objective through management of natural resources that ensures equity among shared interests, respects diverse cultural values and preserves the environmental health of the land, while promoting appropriate economic growth.

The Little Colorado River Watershed Project Action Plan documented the partnership's multi-objective management strategy. Issues addressed included flood and sedimentation mitigation, stream form and function restoration, water conservation and recreation and tourism management. Through community-based cooperation and coordination, the pro-

posed multi-objective management process will increase public awareness and education, networking opportunities and information and technology transfer.

Undertaking the Multi-Objective Management Approach

The Little Colorado River Watershed Partnership works closely with local communities to address water quality concerns. The partnership has developed a "Rapid Resource Assessment" process through which partnership resource professionals are invited into local communities to find solutions to watershed problems. Community concerns have included underground storage tank leakage on tribal lands, irrigation system rehabilitation and managed wetlands concepts that utilize city wastewater effluent and provide bicycling and bird-watching opportunities.

Through the multi-objective management approach, the Little Colorado River Watershed Partnership has also effectively opened doors of communication between two very diverse watershed communities. The Upper Little Colorado River Watershed Group was initiated by water users addressing irrigation system efficiency, sufficient water quantity for agricultural uses and identification of the primary system users in Round Valley. Downstream lies "Zuni Heaven," a sacred area for the Zuni Tribe and, at one time, a very lush riparian area with willow, cottonwood, cattails, turtles, and waterfowl. The Zuni Pueblo hopes to restore the Zuni Heaven wetlands so tribal elders can make their journeys to this place and again collect sacred plants and animals. The Little Colorado River Watershed Partnership has coordinated information exchange issues and opportunities between these two groups.

The proposed multi-objective management process will increase public awareness and education, networking opportunities and information and technology transfer

Cooperation between the watershed partnership and the US Army Corps of Engineers resulted in broadening the scope of a Reconnaissance Study, and the Bureau of Reclamation has begun a Data Inventory and Needs Assessment study. The National Park Service Rivers and Trails Program provided leadership in developing strategies to meet with watershed stakeholders in focus group workshops to define problems, opportunities and concerns in the watershed. Over 25 issues were identified by stakeholders that address all eight partnership watershed goals. The focus group workshops also identified potential strategies, partners and priority actions.

State and Federal Partners

The Little Colorado Resource Conservation & Development Area administers this program and is assisted by the Navajo (AZ) and San Francisco (NM) Soil and Water Conservation Districts. It receives financial support from the federal government, State of Arizona, Counties of Navajo and Apache and Hopi Tribe. Partner organizations in state government include the Department of Game and Fish, Department of Environmental Quality, Department of Water Resources, Navajo Nation Water Resources Department and Zuni Pueblo. Federal support comes from the US Army Corps of Engineers, EPA, USDA Forest Service, USDA Natural Resources Conservation Service, DOI National Park Service and DOI Bureau of Reclamation.

The Steamboat Creek Watershed

Watershed Restoration on Private Land

Steamboat Creek has historically been a valuable water resource in the West and provided early settlers with water for agricultural uses. The creek originates at the outlet of Little Washoe Lake in the State of Nevada and meanders for 17.5 miles to the Truckee River. The Steamboat Creek Watershed encompasses approximately 200 square miles in Washoe County, Nevada.

Land in the watershed is currently undergoing a transition from agricultural to urban uses. The impacts of land development, water diversion, and bank erosion are increasing nonpoint source pollution in the watershed. The Nevada Division of Environmental Protection found excessive levels of sediment, nitrogen, phosphorous and trace metals in the Steamboat Creek and included the creek on the state's list of "target impaired waters." The creek constitutes the largest source of pollution to the Truckee River.

The Steamboat Creek Restoration Plan

With funding from a Clean Water Act grant, the Washoe-Storey Conservation District initiated the Steamboat Creek Restoration Plan to promote voluntary efforts to improve the creek's water quality and re-establish vegetation and wildlife habitat. Completed in 1998, the plan provides recommendations and designs for restoration activities, coordinates stakeholder efforts and attempts to increase public awareness and involvement in water quality concerns. The plan focuses on encouraging voluntary implementation of both off-stream and on-stream best management practices (BMPs) by private landowners, who own 98 percent of the land in the watershed.

The Small Ranch Program

Understanding the importance of involving landowners in Steamboat Creek restoration actions, the University of Nevada Cooperative Extension Service launched the Small Ranch Program to assist in BMP implementation on private properties. The BMPs address erosion control, animal waste management, pasture and irrigation water management, integrated pest management and well and septic system care and maintenance. BMP projects are supported by program classes, workshops and work parties.

The Washoe-Storey Conservation District and the US Army Corps of Engineers augment voluntary restoration efforts in the watershed by both designing some projects and reviewing others. They are also working with the University of Nevada on a feasibility study for a wetlands creation project. Through this coordinated mix of public and private activities, Steamboat Creek stakeholders are striving to restore and protect the watershed.

The plan focuses on encouraging voluntary implementation of both off-stream and on-stream best management practices by private landowners, who own 98 percent of the land in the watershed

State and Federal Partners

Steamboat Creek Restoration Plan projects receive financial support from the federal government and the State of Nevada. Partners in state government include the Division of Environmental Protection and the University of Nevada Cooperative Extension Service. Federal support comes from the US Army Corps of Engineers, USDA Natural Resources Conservation Service, EPA and DOI Fish and Wildlife Service.

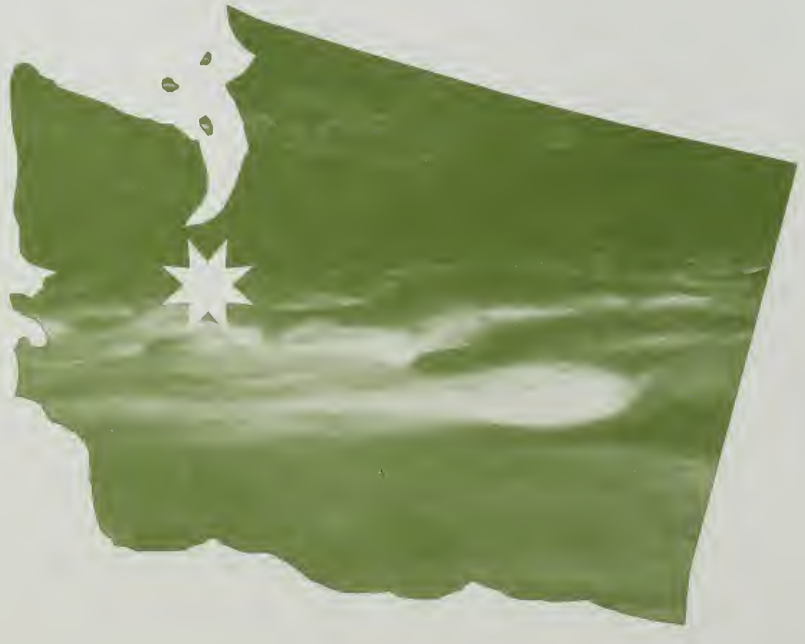
The Haskell Slough Watershed

Excavation Resurrects Aquatic Habitat

Haskell Slough is an important fish overwintering and rearing area for Puget Sound chinook, coho, steelhead and chum. The Haskell Slough Watershed is a system of streams and ponds connected to the Skyhomish River. The system is located near the City of Monroe in the Tualco Valley in Snohomish County, Washington.

The project has already restored salmon production to Haskell Slough, after 50 years of limited or no production

In the 1930s, the system was diked upstream, and years of intermittent flooding and silt deposits isolated the system from the Skyhomish River. Human impacts, such as development, roadway construction and agricultural runoff, filled in the channels between the system's ponds. As a result, adult or juvenile salmon washed into the system during high water periods were blocked from returning to the river and the ocean. Trapped fish either died out naturally or were eaten by predators. Salmon production almost completely disappeared from Haskell Slough.



Reconnecting the Stream System

In 1996, the NOAA National Marine Fisheries Service and Northwest Chinook Recovery initiated the Haskell Slough Salmon Restoration Project, a cooperative effort that included private landowners and a coalition of non-profit organizations and state and federal agencies. The project partnership also included the Tulalip and Upper Skagit Tribes. After two years of planning and design, the project began implementation of its strategy for the restoration of Haskell Slough's salmon habitat in 1998.

Phase one of the project, channel construction, was completed in 1998. Phase two work restored 3.5 miles of river bed by excavating 7,000 feet of stream channels connecting 11 existing large, groundwater-fed ponds. The excavation, completed in the spring of 1999, connected the downstream part of the system to the river and ensures a year-round flow through the entire Haskell Slough. Phase two also involved installation of rootwads, large woody debris, log weirs and other structures to enhance the salmon rearing habitat. A simple monitoring system of fish traps allows project participants to track progress and the quantity of fish in the system.

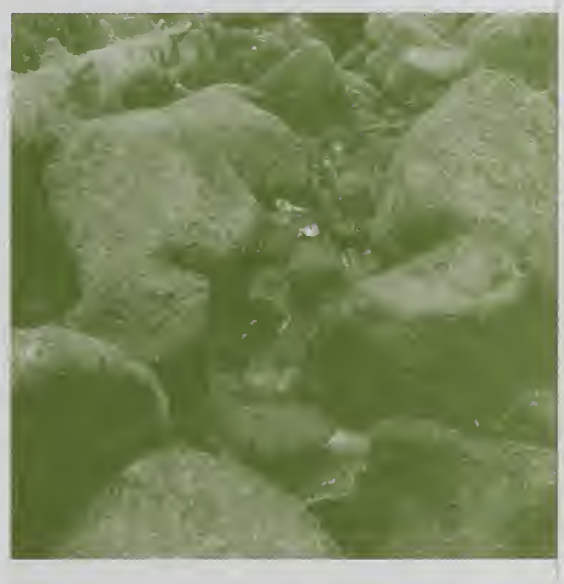
Reconstructing Fish Habitat

The restored channels will provide overwintering and summer habitat for juvenile salmon that enter voluntarily or due to flooding events. Seepage of river water through the existing dike and high quality groundwater will supply the salmon with clean water while the slough environment will protect them from the elevated velocity and turbid flows of the adjacent river.

State and Federal Partners

The Salmon Restoration Project receives financial support from the federal government, State of Washington, Stilliguamish-Snohomish Fisheries Enhancement Task Force, Northwest Chinook Recovery, National Fish and Wildlife Foundation and Daley Design, with local support through the Snohomish Conservation District. State support for the project comes from the Department of Fish and Wildlife and the Interagency Committee for Outdoor Recreation. Federal partners include the DOI Fish and Wildlife Service, USDA Natural Resources Conservation Service and NOAA National Marine Fisheries Service.

The project has already restored salmon production to Haskell Slough, after 50 years of limited or no production. In May 1999, approximately 10,000 coho salmon fry were counted swimming into the slough. Adult salmon have returned to the high water in the lower portion of the system, and juvenile salmonids have either washed into the system or entered it voluntarily. The project manager predicts that, within four years, "several thousand adult coho will be produced by the system, as well as increased numbers of chinook, steelhead and searun cutthroat."



The Teanaway River Watershed

Restoring Fish Habitat

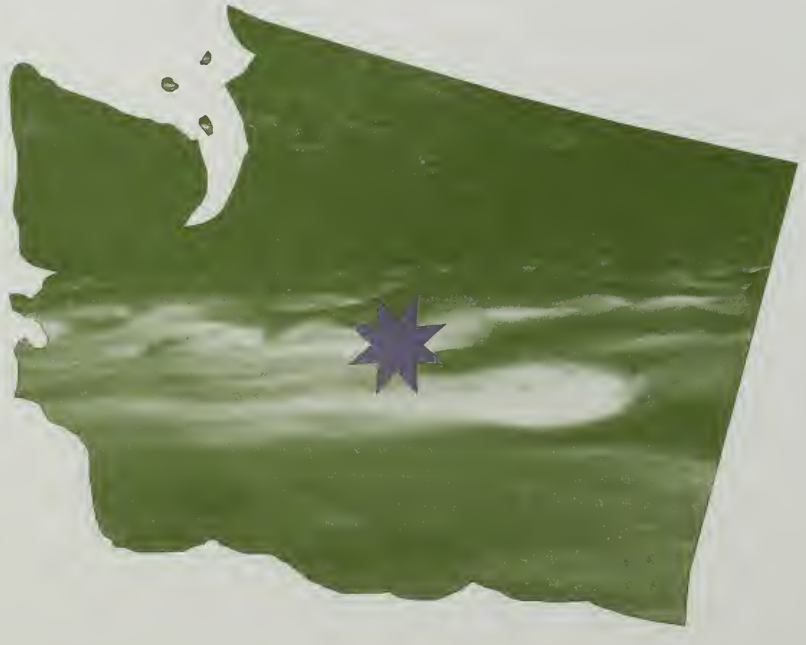
The Teanaway River is a tributary to the Yakima River and has historically been an essential habitat for spring chinook, coho and steelhead. The Teanaway River Watershed is located in Washington State.

As natural runoff declines during the summer and fall, the Teanaway River's instream flows fall. These declines, coupled with peak irrigation demand, often dewater sections of the river and cause barriers to the migration, spawning and rearing of anadromous fish. As a result, the Teanaway River's steelhead and bull trout are listed as endangered species. The river is included in Washington State's List of Impaired Waters for inadequate stream flow and excessive temperature levels.

Bringing Back the Fish

In 1996, the Bureau of Reclamation formed the Teanaway Study Group with representatives from the Yakama Nation, Bonneville Power Administration, Washington Department of Fish and Wildlife, U.S. Department of Energy, USDA Natural Resources Conservation Service, local land owners and irrigation water rights users. The group examined options to increase instream flows, enhance water supplies and conserve and restore salmon habitat.

The property's irrigation water right has been transferred to a permanent instream flow water right; this transfer is the first of its kind in the State of Washington



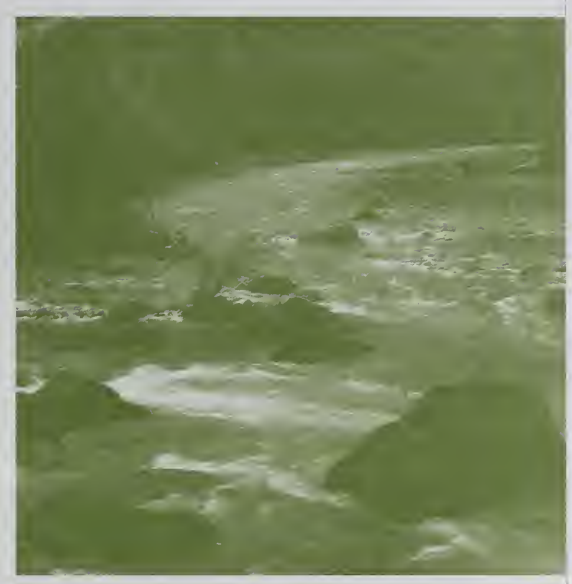
The Teanaway River Watershed partners hope to boost instream flows and restoration of salmonid habitat through land acquisition. In

1999, two properties were identified as essential habitats by the Yakima River Basin Water and Land Acquisition Program Working Group, which includes representatives from the Yakama Nation, Washington Department of Fish and Wildlife, US Department of Energy, US Fish and Wildlife Service and local communities. The group acquired one of these properties; negotiations are underway to place a conservation easement on the second property that will permanently restrict certain future land uses. The restoration plan for the acquired 40-acre parcel of land involves access road closure, native vegetation plantings and dike removal. The property's irrigation water right has been transferred to a permanent instream flow water right; this transfer is the first of its kind in the State of Washington.

Innovative Water Conservation Systems

To increase both instream flows and the reliability of the water supply for irrigation purposes, the Yakama Nation and Bonneville Power Administration are constructing three water conservation systems. The three entities have over 600 acres of land, or approximately half of the irrigated lands in the basin, and the accompanying 4000 acre-feet of water rights. The systems will move all original irrigation diversion points on their lands at least three miles down the river, which will allow a transfer of between 30 to 50 percent of the original irrigation water right to an instream flow water right. In return for the "saved" water, the project will provide local land and water rights owners with a new water conservation system, which will give them a more reliable supply of irrigation water.

To alleviate the impact of excessive temperatures in the watershed, the Washington Department of Ecology is preparing a temperature Total Maximum Daily Load (TMDL) for the Teanaway Basin and is forming a workgroup of local, state and federal landowners and agencies. Implementation measures will focus on reducing sedimentation and conserving riparian zones, water and stream flows.



State and Federal Partners

The Teanaway River Watershed initiatives receive financial support from the federal government, State of Washington and Bonneville Power Administration, with local support through the Klickitat County Conservation District. State partners include the Department of Fish and Wildlife, Department of Ecology, Governor's Salmon Recovery Funds Program, Yakama Nation, Northwest Power Planning Council, University of Montana and Central Washington University. Federal support comes from the Department of Energy, USDA Natural Resources Conservation Service, EPA, DOI Fish and Wildlife Service and DOI Bureau of Reclamation.

The Napa River Watershed

Managing Land Use and Development in a Riverine Estuary System

Stretching 50 miles from Mt. St. Helena to San Francisco Bay, the Napa River and its 47 tributaries form a linear wilderness running through the heart of an intensely farmed and partially urbanized valley. The Napa River Watershed also serves as a valuable water resource for a local population of over 120,000 people. The watershed encompasses 450 square miles in Napa County, California.

The watershed serves as a valuable water resource for a local population of over 120,000 people

The Napa River Watershed historically supported a dense riparian forest, significant wetland habitat and spawning areas for fish such as salmon and steelhead. The pressures of urbanization, agriculture and grazing have degraded the watershed's habitats and drastically increased the rates of erosion and sedimentation. Since 1800, an estimated 6,500 acres of historical valley floor wetlands have been drain or filled, 19,700 acres of the watershed are now under hardened pavement or rooftops and another 26,000 acres have been developed to intensive cultivated agriculture. At the same time, much of the river system has been altered by straightening channels, hardening banks, changing the flow, and constructing levees. These alterations have made the natural drainage system insufficient to prevent extensive flooding in the area. Since 1862, more than 27 major floods have plagued the Napa Valley, resulting in significant loss of life and damage to property. The 1995 flood damaged 227 businesses and residences at a cost of over $100 million.

Restoring the River

In 1996, over 50 watershed stakeholders, including federal, state and

regional agencies and local organizations, formed a partnership to address this periodic flooding. This coalition hopes to accomplish this task by reconnecting the Napa River to its floodplain and creating wetlands while maintaining fish and wildlife habitat and retaining natural river characteristics.

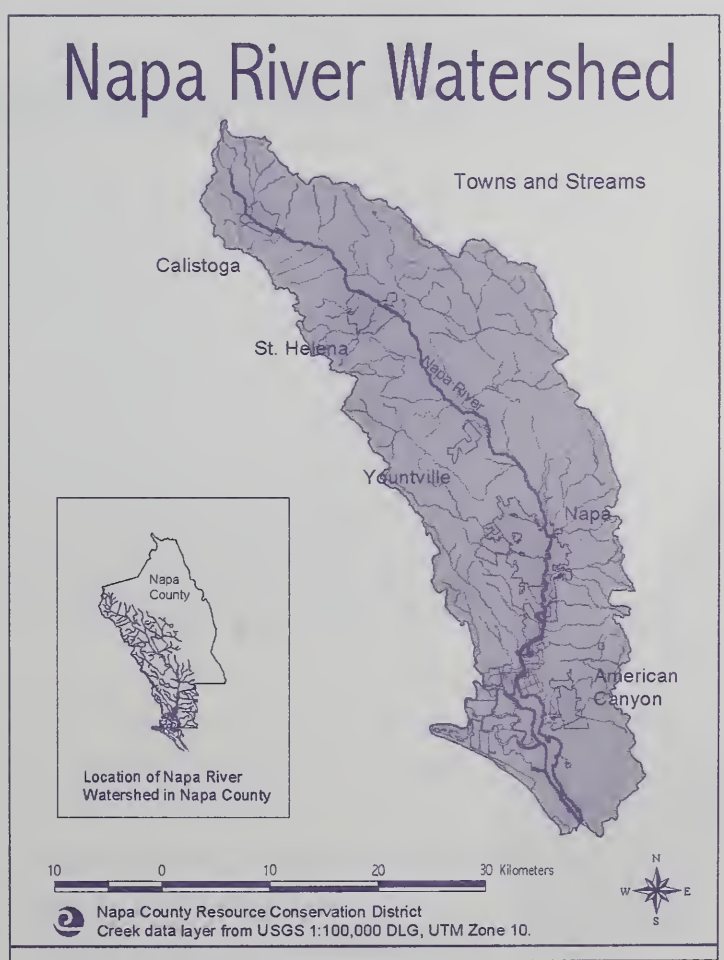
One of the major features of the project is the planned purchase of over 300 parcels of land (720 acres) along a 6.9 mile stretch of the river. These lands will include mudflats, tidal marshland, seasonal wetlands, riparian forest, and high-value woodlands. Other project features include dike removal, wetland and marshplain creation, floodplain restoration, channel modifications, bank stabilization, and building demolition.

Napa River Watershed Owner's Manual

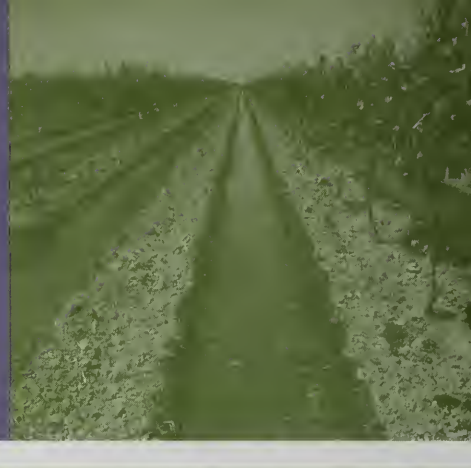
Watershed stakeholders have also worked together to develop and implement a management plan for the watershed called the Napa River Watershed Owner's Manual. The management plan enabled creation of the Conservation Regulations Community Task Force, which prepared an ordinance that requires an erosion control and water protection plan for all development on slopes exceeding five percent. The plan also supports the Napa Sustainable Wine Growing Group. The group is working to establish voluntary farm management guidelines.

State and Federal Partners

The Napa River Watershed restoration partnership receives financial support from the federal government, State of California and Napa County Flood Control and Water Conservation District, with local support through the Napa County Resource Conservation District. State partners include the Department of Fish and Game, Coastal Conservancy and State Lands Commission. Federal support comes from the Federal Emergency Management Agency, USDA Natural Resources Conservation Service, EPA and US Army Corps of Engineers.



The Panoche-Silver Creek Watershed



Protecting the Regional Economy through Flood Management

As a result of historical volcanic activity, the Panoche-Silver Creek Watershed in the State of California contains some of the largest deposits of selenium in the world. The watershed comprises approximately 300,000 acres and ranges in elevation from 100 to 5,000 feet above sea level. The Panoche-Silver Creek Watershed is located in the Coastal Range and San Joaquin Valley, 35 miles west of Fresno, California.

Unfortunately, the natural selenium deposits and similar deposits of boron and other salts contribute to contamination of the watershed's surface water. Development of the lower watershed has virtually eliminated the creek channel and, as a result, continual flooding and sediment transport has deposited the selenium, boron and other salts into the region's waters. This flooding also increases already excessive levels of streambed and streambank erosion and sedimentation in the watershed. Flooding damages the watershed's agricultural land and industry, an important component of the local, county and state economies. A 1998 survey estimated damage costs to be $370 per acre.

Controlling the Floods

In 1989, a joint effort between federal, state and local agencies, landowners and water districts created the Panoche-Silver Creek Coordinated Resource Management and Planning (CRMP) Program. After completing a sedimentation study of the 30,000-acre confluence of the Panoche and Silver Creeks,

By concentrating on flood, erosion and sedimentation concerns, partners in the Panoche-Silver Creek Watershed hope to improve water quality and wildlife habitat

program partners developed a watershed management plan to address flood and erosion control and sediment transport.

While most program initiatives are either in the planning phase or underway, some projects have been completed. For instance, in two "Clinic Programs," watershed stakeholders worked with the California State University Fresno School of Agricultural Sciences and Technology to construct a riparian area along Panoche Creek. A gauging station was also installed on Panoche Creek to support monitor-

ing and assessment aspects of the CRMP program.

Current projects include the installation of riparian filter strips, revegetation, revetment and stabilization of the channel bed. Additionally, an erosion control structure is being developed to reduce the flow and velocity of runoff. A project is also taking an inventory of the regional population of tamarisks, an invasive species of salt cedar, as a first step toward the development of an eradication program.

Future CRMP Projects

Future actions include restoring riparian pastures and corridors, revegetating filtration zones and constructing an erosion control structure in the Panoche drainage for flood control purposes. CRMP program partners will also support the activities of another Panoche-Silver Creek Watershed partnership, the Central Valley Project. The Central Valley Project and the Bureau of Land Management have designated the watershed as an Improvement Area and plan to purchase a 9-mile-long, 1-mile-wide corridor for land retirement and flood control.

By concentrating on flood, erosion and sedimentation concerns, partners in the Panoche-Silver Creek Watershed hope to improve water quality and wildlife habitat. Those improvements, in turn, will benefit the regional economy and all of the watershed's inhabitants.

State and Federal Partners

The Panoche-Silver Creek CRMP program receives financial support from the federal government, State of California, City of Mendota, Central Valley Project, Westside Resource Conservation District and Silver Creek Drainage District. Partners in state government include the Department of Water Resources, Department of Transportation, Regional Water Quality Control Board, Department of Fish and Game, University of California Cooperative Extension Service, CALFED Bay-Delta Program and California State University Fresno School of Agricultural Sciences and Technology. Federal support comes from the EPA, DOI Geological Survey, DOI Bureau of Land Management, DOI Bureau of Reclamation and USDA Natural Resources Conservation Service.

The Tijuana River Watershed

Reconstructing a Coastal Estuary

The Tijuana River Watershed is a 1,735 square mile intertidal coastal estuary located on the international border between the United States and Mexico, with one-quarter of the land contained in San Diego County, California. Extreme changes in streamflow make the Tijuana Estuary one of the nation's most variable estuaries and an important part of the National Estuarine Research Reserve System.

With a multitude of habitats including sand dunes and beaches, open tidal channels and mudflats, sand marshes and fresh-brackish marshes, the Tijuana Estuary has approximately 380 species of birds and at least 29 species of fish. Six species of birds, several invertebrate species and one plant are endangered.

Land in the estuary is mainly used for agricultural, military and recreational purposes. For years, agricultural and military activities degraded the region by filling and diking significant stretches of salt marsh. Throughout the estuary, human disturbances have modified and endangered critical habitats, most often by increasing sedimentation.

Organizing to Save Critical Habitats

For over 15 years, scientists at the Pacific Estuarine Research Laboratory unit at the San Diego State University worked in conjunction with NOAA to analyze the watershed and human impacts on the estuary. Research has also been conducted by scientists associated with the University of California

The Tijuana River Watershed is a 1,735 square mile intertidal coastal estuary located on the international border between the United States and Mexico

Scripps Institute of Oceanography. Due to the results of these studies, a broad regional stakeholder partnership was formed which devoted its efforts to the restoration and expansion of key estuarine habitats. This partnership, the Southern California Wetlands Recovery Project, is a coalition of 14 state and federal agencies and numerous local organizations.

Habitat Reconstruction

The partnership initiated a model marsh project to expand wetland

habitat and restore tidal marsh through excavation, revegetation and natural species colonization. The first phase of this project, completed in 1997, connected two areas of tidal saltmarsh, created two acres of new saltmarsh and channel habitat and enhanced circulation to approximately 200 acres of the estuary's north arm.

The Southwest Wetlands Interpretive Association worked with watershed stakeholders to complete the second phase of the model marsh project: excavation of 135,000 cubic yards of fill material from a former saltmarsh, reconstruction of a tidal marsh plain and creation of a network of tidal channels. Future phases of the project will establish coastal sage shrub habitat, replenish beach habitat and use excavated material to recontour an abandoned gravel quarry.

Several other efforts support restoration activities and enhance stewardship of the watershed's resources. Interpretive signs have been placed on four miles of trails to increase public education and awareness. Bilingual nature classes, site visits and site-based training for teachers are part of a broad initiative to heighten public participation. Estuarine stakeholders hope to use these education and outreach programs to sustain the restoration and preservation activities undertaken throughout the estuary.

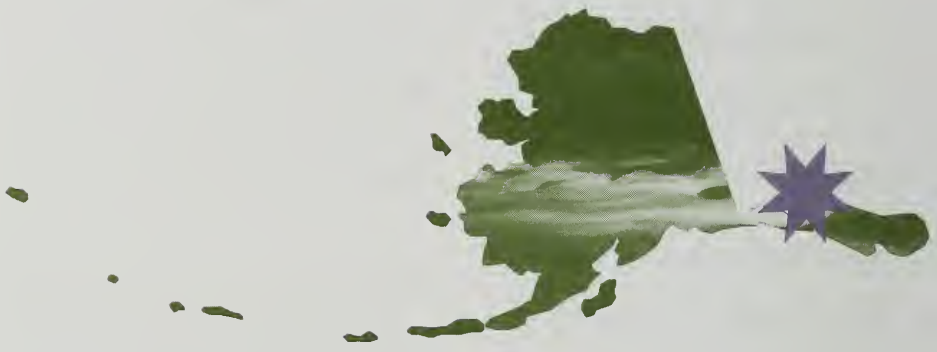
State and Federal Partners

The Tijuana River National Estuarine Research Reserve Model Marsh Project receives financial assistance from the federal government, State of California, California Association of Resource Conservation Districts and South Coast Resource Conservation and Development Area. State partners include the Department of Fish and Game, California EPA, Coastal Conservancy, State Coastal Commission, State Resources Agency, State Lands Commission, State Water Resources Control Board, San Diego State University and University of California. Federal support comes from the USDA Natural Resources Conservation Service, US Army Corps of Engineers, EPA, DOI Fish and Wildlife Service and NOAA National Ocean Service.

The Duck Creek Watershed

Combining the City and the Wilderness

The Duck Creek Watershed is a Clean Water Action Plan National Showcase Watershed. Located within the limits of the City and Borough of Juneau, Alaska in the Mendenhall Valley, the watershed encompasses 4,000 acres of tidal marsh and drains approximately 1080 acres, or 1.7 square miles. Duck Creek itself is a small, anadromous fish stream over 3 miles in length with two tributaries, East Fork and El Camino.



The watershed is a valuable resource for the City of Juneau. It is used for recreation and aquatic education, provides open space and serves an important role in stormwater and flood control. As a result of its warm groundwater and extensive pond habitat, Duck Creek supports a large overwintering population of coho salmon juveniles which migrate each fall from the nearby Mendenhall estuarine wetlands.

Urban development has removed most of the woody debris that provides natural structural diversity and has led to a wider, shallower and slower stream. The Alaska Department of Environmental Conservation lists Duck Creek as impaired because of urban runoff, water quality limitations and habitat modifications resulting from inadequate stewardship.

Cooperation in Alaska

In 1993, the Duck Creek Advisory Group (DCAG) formed to coordinate water quality and anadromous fish habitat restoration activities. Primarily through monthly meetings and a newsletter, the group organizes the efforts of 25 organizations, including the City and Borough of Juneau, state and federal agencies, private businesses, conservation organizations and homeowners. Using a watershed approach focused on enforcement, management and restoration, DCAG completed a comprehensive management plan and leads restora-

tion projects and pollution control activities throughout the watershed. A pilot study was conducted to determine the feasibility of restoring salmon spawning habitat by reconfiguring the stream channel, removing sediment and increasing dissolved oxygen levels.

The Duck Creek Watershed stakeholders employ innovative techniques in supporting the restoration of water quality and fish habitat. A two-acre dredge pond from the 1940s had become a source of poor water quality and contributed to the high mortality of overwintering coho salmon. Near the East Fork of Duck Creek, a stormwater drainage system generated 20,000 cubic yards of fill material requiring disposal. A cooperative partnership between the City and Borough of Juneau, two area construction firms, a local church and the National Marine Fisheries Service used the fill material from the drainage system to convert the pond into a stormwater treatment marsh. The wetland's fill material caps the source of iron-rich groundwater, while the aquatic plants filter suspended sediment and iron particles from the water.

In other projects, stream crossings are being improved and experimental "snow fences," designed to limit snow and road sand sedimentation, are being installed. The Southeast Alaska Guidance Association has helped complete a number of streambank revegetation and channel modification projects, including willow stakes and grass plantings. Several important restoration projects have been completed with assistance from the US Fish and Wildlife Service's Partners for Wildlife Program.

The Duck Creek Advisory Group received Coastal America's 1999 National Partnership Award in recognition of its success in developing cooperative partnerships for coastal resource restoration. The endorsement helped obtain technical and financial assistance from the US Army Corps of Engineers for management plan projects.

The Duck Creek Advisory Group formed to coordinate water quality and anadromous fish habitat restoration activities and organized the efforts of 25 organizations

State and Federal Partners

This community-based project receives financial support from the federal government, State of Alaska, City and Borough of Juneau, Southeast Conference Resource Conservation and Development Area and Mendenhall Watershed Partnership. State partners include the Department of Environmental Conservation, Department of Fish and Game, Department of Natural Resources, Department of Transportation and Public Facilities and Governor's Office. Federal support comes from the US Army Corps of Engineers, DOI Fish and Wildlife Service, DOI Geological Survey, Department of Transportation, EPA, USDA Forest Service, USDA Natural Resources Conservation Service and NOAA National Marine Fisheries Service.

The Ko'olaupoko Watershed

Working Together on Tropical Watershed Restoration

The Ko'olaupoko Region in Hawaii reaches from the Ko'olau mountains to the reefs of Kane'ohe, Kailua and Waimanalo Bays and includes eleven watersheds. Marine Corps Base Hawaii (MCBH) primary landholdings on O'ahu are within the region. They include the 187 acre Waikane Valley, 1,045 acre Marine Corps Training Area-Bellows (MCTAB) in Waimanalo and 2,951 acre Mokapu penisula, which includes a 482-acre Nu'upia Ponds wetland complex within the Mokapu Central Drainage Basin.

Population growth and development throughout the Ko'olaupoko Region has increased erosion and polluted stormwater runoff. Concern about these nonpoint source pollution issues led to the inclusion of regional waterbodies, such as the Waimanalo stream, in the State of Hawaii's List of Impaired Waters, which are subject to a Total Maximum Daily Load (TMDL) study. The Ko'olaupoko Region has also been designated as Priority 1 for watershed restoration in the state's Unified Watershed Assessment.

Nonpoint Source Pollution Mitigation on the Mokapu Peninsula

Until the mid-1990s, the focus of MCBH's collaborative community involvement and interagency partnership efforts was on projects to improve water quality, water circulation and endangered waterbird habitat within the confines of the Nu'upia Ponds wetland complex. Resource management plans developed for Nu'upia Ponds in 1997 and Mokapu Peninsula in 1998 expanded the resource management strategy to comprise the entire Ko'olaupoko Region. The 1998 MCBH Mokapu Manual for Watershed Health and Water Quality provided technical guidelines for such activities as riparian habitat restoration, community-based water quality monitoring and fluvial geomorphology.

Several projects along the Mokapu Central Drainage Channel are being implemented to alleviate nonpoint source pollution and habitat problems. For instance, a drainage spillway next to a maintenance compound has been redesigned to augment wetland creation while also mitigating nonpoint source pollution, low groundwater table, runoff and flooding problems. A 1999 streamside barracks complex project includes native landscaping and construction of a 3,200 square meter sediment retention basin designed to attract native waterbirds while implementing Best Management Practices (BMPs) for stormwater management. A Golf Course Pond Maintenance Manual addresses resident endangered waterbird needs in three half-acre ponds.

Community Involvement and Participation

Water quality and habitat restoration projects in the Ko'olaupoko Region benefit from cooperation and coordination among federal, state and local partners. In the past year alone, over 700 volunteers have participated in 15 watershed service projects sponsored by MCBH. As a result, counts of the resident population of endangered Hawaiian stilt in the ponds are more than double what they were 20 years ago. Also, more than 300 individuals from schools and community organizations have taken "watershed tours." The grass-roots participation process enhances stewardship and the sustainability of the watershed restoration projects.

One innovative project especially highlighted the positive effects of community-based watershed restoration. In this project, watershed partners installed several native plant plots and used fluvial geomorphology techniques to combat erosion of approximately 25,000 square feet of riparian streambank area on Mokapu and in MCTAB. The project sponsored a graduate-level University of Hawaii course on Watershed Education in which 16 Department of Education teachers at the Mokapu and Aikahi elementary schools received basic training in watershed management science. The teachers now satisfy core teaching requirements by involving their students in the implementation of special lesson plans assisting MCBH in the design, planting and maintenance of riparian native plant gardens. Such projects strengthen community awareness and participation in watershed restoration and lay the foundation for future restoration and protection actions in the entire Ko'olaupoko Region of watersheds.

Mōkapu Central Watershed

In the past year alone, over 700 volunteers have participated in 15 watershed service projects sponsored by Marine Corps Base Hawaii

Photos courtesy of Diane Drigot

State and Federal Partners

The watershed restoration projects receive financial support from the federal government and the State of Hawaii. Partner organizations in state government include the Department of Education, Department of Land and Natural Resources and University of Hawaii. Federal partners include the USDA Natural Resources Conservation Service, EPA, US Marine Corps, US Air Force, US Army National Guard and US Army Corps of Engineers.

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